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EXXONMOBIL GREENPOINT PETROLEUM REMEDIATION PROJECT

Address: 400 Kingsland Avenue, Greenpoint, Brooklyn, New York

Tax Lot Parcel(s): (Block, Lot) – (2612, 1); (2608, 1); (2585, 1); (2607, 6); (2584, 1)

Latitude: 40° 43' 51.98"

Longitude: -73° 56' 29.67"

Regulatory Programs/Numbers/Codes:

EPA Nos: 400 Kingsland – NYD000824540, 38 Varick Street – NYD001233113

NYSDEC SPDES No. 0267724

NYSDEC PBS: Terminal (2-603027)

NYSDEC LI Well# – 2-6101-00107-00027

The EMGPRP includes the operation of two groundwater extraction systems and LNAPL recovery systems, which include: the Recovery and Containment System (RCS) located at 400 Kingsland Avenue (i.e., former Brooklyn Terminal); and the Off-Site Recovery System (ORS) located at 5 Bridgewater Street. More detailed information for these treatment systems is included in Section 10.1. Both systems consist of dual-pump, recovery wells, water treatment systems, and separate outfalls. Figure 3 shows the locations of the 21 recovery wells, as well as the water treatment plants. The groundwater is currently treated to satisfy the discharge requirements specified in the New York State Pollutant Discharge Elimination (SPDES) Permit (No. NY-0267724) for Outfall 001 (i.e., RCS effluent) and Outfall 002 (i.e., ORS effluent), prior to discharge to Newtown Creek. The permit limits and exceedances are summarized in Section 9.3.

Analytical Data Status: ☒ Electronic Data Available ☐ Hardcopies only
☐ No Data Available

The following Summary Report was prepared to summarize environmental conditions being addressed by the ExxonMobil Greenpoint Petroleum Remediation Project (EMGPRP) within the former ExxonMobil Brooklyn Terminal (hereafter referred to as the Site) consisting of approximately 18 acres. The Site is part of the overall EMGPRP, which is regulated under the Consent Decree between the State of New York and ExxonMobil, which was filed on March 1, 2011, in the United States District Court, Eastern District of New York (Consent Decree). The

Site is located within the Greenpoint Section of Brooklyn, New York (Figure 1). The boundaries of the Site are depicted in Figure 2. As defined in the Consent Decree, where the Site borders Newtown Creek, the Site extends up to, and includes, any bulkheads of any type that border the Site.

ExxonMobil's predecessor companies (namely Standard Oil, Standard Oil Company of New York [SOCONY], SOCONY-Vacuum Company, and Mobil Oil Corporation [Mobil], collectively referred to herein as ExxonMobil) historically conducted petroleum refining and distribution terminal operations within the Site. The Site is currently owned by ExxonMobil and was formerly utilized for petroleum refining, storage and distribution operations. The Site is broken up into three parcels, which have been referred to as Kingsland Yard, Monitor Yard and North Henry Yard as shown in Figure 2.

This Summary Report is intended to provide a summary of available information related to the Site, based on previous investigations completed on behalf of ExxonMobil. More detailed information regarding the Site can be found in previous reports prepared by ExxonMobil and submitted to the New York State Department of Environmental Conservation (NYSDEC), as well as in reports prepared by other third parties conducting activities adjacent to the Site. The most recent submittal containing a summary of the Site is the Conceptual Site Plan (CSP) (Roux Associates, 2012), prepared in accordance with the Corrective Action Plan (CAP) included as Exhibit 2 to the Consent Decree. The intent of the CSP was to provide a preliminary summary of the Site status based upon the results of the investigation and remediation activities completed to date, and to provide an anticipated schedule for contemplated additional investigation and remediation activities at the Site.

It should be noted that another property is owned by ExxonMobil within the vicinity of the Site. This property was purchased by ExxonMobil in 2009 and includes the administrative offices utilized to manage the EMGPRP. The property is located at 38 Varick Street, Brooklyn, NY (Block - 2664, Lot - 9). This property was never utilized as part of ExxonMobil's historic petroleum operations.

1 SUMMARY OF CONSTITUENTS OF POTENTIAL CONCERN (COPCS) TRANSPORT PATHWAYS TO THE CREEK

The current understanding of the transport mechanisms of contaminants from the upland portions of the Site, as defined below, to Newtown Creek is summarized in this section and Table 1.

Overland Transport: No specific evidence of overland transport was identified in the available Site records. The Site was originally designed to contain stormwater, is relatively flat, and largely unpaved, which allows for potential infiltration of stormwater. In addition, the Site has a stormwater drainage system to collect stormwater in catch basins to then be conveyed via underground piping to an in-ground oil water separator prior to discharge to Newtown Creek, as discussed later in this Summary Report. The Site has always maintained a compatible stormwater system based on existing information.

The historic and current pathways are incomplete.

Bank Erosion: As shown in Figure 2, the Site has approximately 650 feet of frontage along Newtown Creek. The entire frontage is composed of a steel sheeted bulkhead with an exterior wooden whaler system. The bulkhead is maintained with a cathodic protection system. Based on the available records, the Site always maintained a bulkhead.

The historic and current pathways are incomplete.

Groundwater: Light non-aqueous phase liquid (LNAPL) is present beneath portions of the Site and has been the subject of ongoing investigations and remediation activities since the LNAPL accumulations were identified in 1978 (Roux Associates, 2012). The overall natural direction of groundwater flow is northeast towards Newtown Creek, under natural static conditions. However, the groundwater flow is influenced by the groundwater extraction activities associated with ExxonMobil remediation systems within the Site. With the operation of the existing recovery wells, a majority of the groundwater that contains potential LNAPL is hydraulically captured and treated by ExxonMobil. In addition, the historic groundwater gradient beneath portions of the Site has also been away from Newtown Creek and generally to the south. This reversal of the natural hydraulic gradient was a result of municipal pumping of the regional aquifer (Roux Associates, 2012). As discussed in Section 10, currently, the portion of the Site that contains LNAPL is hydraulically controlled by existing remediation systems and remediation activities being conducted by Roux Associates (Roux Associates, 2012) on behalf of ExxonMobil.

The historic pathway is complete and the current pathway is incomplete.

Overwater Activities: The Site utilized barges to transport petroleum products from the Site. Based upon the available information, there has not been a documented release from any overwater activities conducted adjacent to the Site. No overwater petroleum operations are currently completed at the Site and there has been no documented release related to the shipping of petroleum products at the Site.

The historic and current pathway is not complete.

Stormwater/Wastewater Systems: ExxonMobil historically and currently utilizes a stormwater system within the Site. The historic stormwater and refinery wastewater treatment

system included catch basins and subsurface piping to collect waters from throughout the Site. These waters were then conveyed for treatment to the oil/water separator, prior to discharge to Newtown Creek in accordance with the Site SPDES Permit.

At present, the effluent from the stormwater system within the Site is combined with the effluent from ExxonMobil's groundwater treatment facility (i.e., RCS) and the combined treated process water is discharged to Newtown Creek under the same SPDES Permit No. NY-0267724, at Outfall 001, as described below.

The historic pathway is complete and the current pathway is incomplete.

Air Releases: The EMGPRP generates air emissions from the off-gas treatment of the groundwater treatment system. These emissions are under the regulatory oversight of the NYSDEC and are in accordance with Consent Decree requirements and are not depositional.

The historic and current pathway is incomplete.

It should be noted that although some potentially complete historic pathways may have been present, currently all pathways on the Site are incomplete.

2 PROJECT STATUS

The list below contains reports that ExxonMobil has referenced in the past during the preparation of previous reports. Additional third-party reports may exist for properties adjacent to the Site, but information from these reports are not summarized within this Summary Report.

Report Content/Activity		Date(s)/Comments
Phase 1 Environmental Site Assessment	☐	
Site Characterization	☒	On behalf of ExxonMobil, multiple investigations have been competed as detailed in reports dated as follows: ExxonMobil – 1981, 2003, 2006, 2007, 2007-2009, 2012
Remedial Investigation	☒	Geraghty and Miller – 1979 ExxonMobil –2009
Remedy Selection	☒	Major remedial action at the Site includes the installation and operation of the RCS recovery system as detailed in the 2008 AAR (Roux Associates, 2008)

Report Content/Activity		Date(s)/Comments
Remedial Design/Remedial Action Implementation	☒	All existing remedial activities are currently identified as Interim Remedial Measures (IRMS): RCS – Original recovery efforts within the former Brooklyn Terminal started in 1979, upgrades occurred periodically, with the RCS being built in 2005-06 Pipe Removal Activities – completed throughout the former Brooklyn Terminal from 2007-2012

Report Content/Activity		Date(s)/Comments
Use Restrictions (Environmental Easements or Institutional Controls)	☐	
Construction Completion	☐	
Site Closeout/No Further Action Determination	☐	

- NYSDEC Site Code(s): The Site is considered one project under the Consent Decree, but, prior to the Consent Decree, it had a different NYSDEC Site Code: Former Brooklyn Terminal – S224088.
- NYSDEC Site Manager: Edward Hampston

3 SITE OWNERSHIP HISTORY

- Respondent Member: ☒ Yes ☐ No

This section shall summarize the ownership history of the parcels within the Site. ExxonMobil and its predecessors owned and operated all of the parcels within the Site from approximately 1882 (at which time the Standard Oil Trust was formed) until refining operations ceased in 1966. The refinery was subsequently demolished and significant portions of the refinery property were sold, including a large portion that was sold in 1969 to the American Oil Company (Amoco, currently the BP Terminal). The other portions of the former refinery property that were sold are currently a mixture of various types of commercial and industrial land uses not associated with

ExxonMobil, as further described in the CSP. The parcels retained by Mobil in 1969 included: Kingsland Yard, Monitor Yard, North Henry Yard, Northern Crude Yard, and the former Lube Plant. All of these parcels were used for some degree of bulk petroleum storage during the operation of the refinery and, later, the terminal. The North Henry Yard also contained the terminal truck loading rack apparatus for distribution of petroleum products. The property that contained the Lube Plant was sold by Mobil in 1985. The remaining Mobil-owned parcels continued to function as a bulk petroleum storage terminal until officially closed in 1993. The configuration of the operations is summarized in Sanborn Insurance Maps dating from 1887 to the present (Sanborn Insurance Maps, Various).

Owner	Occupant	Type of Operation	Years
ExxonMobil	ExxonMobil	Historically used for petroleum refining, storage and distribution. Currently used for parking.	1882 - Current

4 PROPERTY DESCRIPTION

The Site consists of approximately 18 acres in the Greenpoint section of Brooklyn, New York and is composed of three parcels; Kingsland Yard, Monitor Yard, and North Henry Yard. The Kingsland Yard parcel, Block 2612, Lot 1, consists of approximately 10-acres and is bounded by a construction site to the north, Newtown Creek to the east, the Mendon Truck Leasing and Rental Corporation property, the 369 Kingsland LLC (i.e., truck repair facility) and the BP petroleum bulk storage terminal to the south, and Kingsland Avenue to the west.

Monitor Yard encompasses slightly over 4-acres and is bounded by Greenpoint Avenue to the north, the Broadway Stages Production Studios to the south, Monitor Street to the west, and Kingsland Avenue to the east. Monitor Yard includes New York City tax map Block 2585, Lot 1 (approximately 3 acres) to the north of Calyer Street, Block 2608, Lot 1, (approximately 1 acre) to the south of Calyer Street, and the portion of Calyer Street between North Henry Street and Monitor Street. This portion of Calyer Street is occupied by ExxonMobil pursuant to agreement with New York City (Deed No. A 795-1-8, January 18, 1975) and not accessible to free flowing vehicular traffic.

North Henry Yard is the westernmost parcel of the Site and encompasses a total area of approximately 5.4-acres. The parcel is bordered by Greenpoint Avenue to the north, North Henry Street to the west, various scaffolding and construction companies to the south and Monitor Street to the east. Similar to Monitor Yard, the parcel includes a northern lot (New York City tax map Block 2584, Lot 1) and southern lot (Block 2607, Lot 6) of approximately 2.6-acres and 2.8-acres, respectively, which are separated by Calyer Street.

The Kingsland Yard and Monitor Yard parcels are currently non-operational other than the activities associated with ExxonMobil's Greenpoint Remediation Project. Portions of the Site are leased to third parties for parking.

Topographic elevations (i.e., land surface) of Kingsland Yard are approximately five feet above mean sea level (ft-amsl) along the bulkhead along Newtown Creek and eight ft-amsl along the northern property line. Elevations rise gradually to approximately 14 feet in the southwest corner of Kingsland Yard. The majority of the Site is unpaved except for small parking areas and the RCS groundwater treatment building is present within the center of the parcel. There is one outfall that conveys the combined RCS and stormwater discharge.

Topographic elevations of Monitor Yard are approximately 10 ft-amsl along Greenpoint Avenue (i.e., northern property line) and gradually rise to approximately 15 ft-amsl along the southern property line. The majority of the Site is unpaved.

Topographic elevations of North Henry Yard are approximately nine ft-amsl along Greenpoint Avenue (i.e., northern property line) and gradually rise to approximately 17 ft-amsl along the southern property lines. The majority of the Site is unpaved and there is a large warehouse building that is located in the center of the parcel.

Where the Site borders Newtown Creek, the Site extends up to and includes any bulkheads of any type that border the defined Site.

5 CURRENT SITE USE

A current land-use map of the Site is shown on Figure 5. This map is based upon information available from the New York City Department of Planning website. Based on Figure 5, the entire

Site is zoned for manufacturing. ExxonMobil utilizes the Site in an effort to accomplish the existing remedial activities being conducted as part of the EMGPRP.

6 HISTORIC SITE USE

The Site has been the location of petroleum industry operations for nearly 140 years. In and around the Site, petroleum operations have included, but are not limited to, the former Mobil Brooklyn Refinery and Terminal, the existing BP Terminal, the existing Metro Fuel Oil Terminal, and the former Paragon Oil Terminal.

The following summarizes the historical operations conducted by ExxonMobil within the Site. The configuration of the operations is also summarized in Sanborn Insurance Maps dating from 1887 to the present (Sanborn Insurance Maps, Various). Generally, petroleum refining within the Greenpoint area began in approximately 1866. By 1870, numerous refineries were located along the banks of Newtown Creek. One of these early refineries was the Sone and Fleming Kings County Oil Works (Sone and Fleming Works). In 1882, the Sone and Fleming Works, along with the majority of the other area refineries, were purchased by Charles Pratt and consolidated into the Standard Oil Trust. Following the breakup of the Standard Oil Trust, ownership of the refinery property reverted to the Standard Oil Company of New York (SOCONY) and these operations became the SOCONY (later Mobil) Brooklyn Refinery. The former Mobil Brooklyn Refinery occupied the Site, as well as areas to the north and south, including the property currently occupied by the BP Terminal (Figure 2). The area occupied by the former Mobil Brooklyn Refinery is also referred at times as the Historic Footprint.

Refining operations at the former Mobil Refinery ceased in 1966. The refinery was subsequently demolished and significant portions of the refinery property were sold, including a large portion that was sold in 1969 to the American Oil Company (Amoco, currently the BP Terminal). The other portions of the former refinery property that were sold are currently used for various types of commercial and industrial land uses by third parties. The property retained by Mobil in

1969 included Kingsland Yard, Monitor Yard, North Henry Yard, Northern Crude Yard, and the former Lube Plant. All of these parcels were used for some degree of bulk petroleum storage during the operation of the refinery and, later, the terminal. The North Henry Yard also contained the terminal truck loading rack apparatus for historic distribution of petroleum

products. The property that contained the Lube Plant was sold by Mobil in 1985. The remaining Mobil-owned parcels continued to function as a bulk petroleum storage terminal until it was officially closed in 1993. Some of the storage facilities located within Kingsland Yard remained in operation after 1993 in an effort to support ongoing remediation activities, and because of this, the facility retained permits and a Major Oil Storage Facility (MOSF) licensure until October

2006. Demolition of the remaining tanks and terminal facilities commenced in November 2006. By February 2007, all aboveground tanks, pipelines, buildings and structures associated with former refinery/terminal operations had been demolished. Since 1993 to present, the only petroleum stored at the former Mobil Terminal is LNAPL recovered as part of the ongoing Site remediation activities.

7 CURRENT AND HISTORICAL AREAS OF CONCERN AND COPCS

A summary of information regarding the historical and current potential upland and overwater areas of concern at the Site is contained in Table 1. The following discussion is focused on the environmental conditions being addressed as part of EMGPRP and is not meant to identify Areas of Concern or Contaminants of Potential Concern (COPCs) within those portions of the Site associated with third party operations/properties.

Uplands

As previously described, ExxonMobil historically owned and operated a petroleum refinery and bulk storage terminal (the former Brooklyn Refinery) within the Site

It should be noted that prior to the mid-1800s, a portion of the Site and adjacent areas were comprised of wetlands associated with Newtown Creek. These areas were filled by local municipal government in order to claim the land for future development activity. The locations of marshlands and the ancestral extent of Newtown Creek prior to development, as of 1844, are depicted on a historical United States Coast Survey (USCS) chart provided as Figure 6. Land filling within the Site and adjacent to the Site, and all along Newtown Creek, was managed by local municipal government. Available information indicates that the fill often consisted of various waste materials being generated at the time the filling operation was conducted. These materials are documented as including, but may not be limited to, refuse, garbage, ashes, factory wastes, and other waste materials.

7.1 Overwater Activities ☒ Yes ☐ No

The former Brooklyn Refinery and Terminal operated a petroleum barge transfer station at 400 Kingsland Avenue where barges routinely docked.

7.2 Spills

Some of the key findings included:

- Accumulations of LNAPL were identified in 1978 beneath two main areas, including the "Meeker Avenue Spill" (i.e., off-site area to the south of the Site) and the "Kingsland Avenue Spill" (i.e., Includes the Site, areas directly south of the Site, and the northern portion of the BP Terminal; and
- The only discharge location of LNAPL into Newtown Creek was identified during the 1979 investigation at the northern terminus of Meeker Avenue.

As detailed in previous reports, information concerning potential releases of petroleum within the Site was derived from information received from the United States Environmental Protection Agency (USEPA), the NYSDEC, the New York City Department of Buildings (NYDOB) and the New York City Fire Department (FDNY), and is summarized in the Comprehensive Site Investigation Report (Roux Associates, 2009a). The New York City Department of Health (NYCDOH), the New York City Department of Traffic (NYCDOT), the NYCDEP and the U.S. Army Corps of Engineers were also contacted for information regarding spills, but these agencies did not have any information, or could not provide additional information. Furthermore, the United States Coast Guard was also contacted, but could not provide information because this agency has forwarded all records to the USEPA and no longer maintains records of its own. A list of spills/releases that occurred within the Historical Footprint is presented in Table 4 of the Comprehensive Site Investigation Report. The following summarizes the major spills that were reported within the former Brooklyn Terminal.

- On June 19, 1991, approximately 1,000 gallons of petroleum were released into the pipeline tunnel crossing Greenpoint Avenue at the intersection of Kingsland Avenue. This release was reported to the NYSDEC and assigned Spill No. 9103174. The incident occurred when a flange gasket failed. A vacuum truck evacuated the water/petroleum mixture from the tunnel and the petroleum was evacuated into a storage tank the same day the spill occurred. Any petroleum residues were removed by additional flushing operations undertaken on June 20, 1991. The leaking gasket was replaced and a hydrostatic test was performed on the line. Subsequently, the return to service of the line was approved by representatives of the FDNY. The NYSDEC spill report also indicates that the spill was cleaned up satisfactorily. The NYSDEC closed the spill file on March 30, 1995.

- A spill file was opened by the NYSDEC when allegedly contaminated soil was noted in association with excavation activities at the Monitor Yard. The origin of the release, if any, is not known.

- On September 1, 1994, approximately 33,000 gallons of petroleum were released at the Kingsland Yard. This release was reported to the NYSDEC and assigned Spill No. 9407397. The incident occurred when the structural integrity of an aboveground storage tank failed. The petroleum was released into secondary containment that consisted of a dike area around the tank. Some of the petroleum flowed over the dike and was redirected into a storm drain that discharges into an in-ground oil-water separator. The NYSDEC spill report indicates that the spill was cleaned up satisfactorily. The NYSDEC closed the spill file the same day the spill had occurred, on September 1, 1994.

- On July 29, 1997, petroleum-contaminated soil was encountered during the installation of a 300-foot section of pipeline on Kingsland Avenue by the Buckeye Pipeline Company. This incident of soil contamination was reported to the NYSDEC and assigned Spill No. 9705141. The Buckeye Pipeline Company arranged for the removal and disposal of approximately 1,000 tons of petroleum-contaminated soil, as well as 100,000 gallons of petroleum-contaminated water. The NYSDEC deemed the incident part of the ongoing Greenpoint Remediation Project. The NYSDEC closed the spill file on January 5, 2006.

The above summary identifies spills that occurred during the execution of ExxonMobil operations or were recorded to be present within the former Brooklyn Terminal.

8 PHYSICAL SITE SETTING

The hydrogeologic conditions within various areas of the Site have been characterized during several previous investigations as listed in Section 2.0. These investigations included the installation of monitoring and recovery wells, soil borings, Cone Penetrometer Test (CPT) borings, reviews of published reports regarding the Site, and reviews of well records obtained from the NYSDEC. The investigations also included aquifer testing, geotechnical analysis, and extensive gauging of groundwater and surface-water levels. Plate 1 provides a Site Plan depicting the locations of many of the wells and borings that have been completed on behalf of ExxonMobil.

The Site Conceptual Model of hydrogeologic conditions is described below based upon the collective results of the prior investigations. The focus of the discussion is on the key hydrogeologic conditions that appear to influence the nature and extent, migration, and remediation of contamination at the Site.

8.1 Stratigraphy

The stratigraphic units underlying the Site consist primarily, from land surface down, of: artificial fill, fluvial sediments and marsh deposits associated with Newtown Creek (i.e., historical creek and marsh sediments), glacially-deposited sediments (i.e., glacial drift), and bedrock. The glacial drift beneath the Site includes both glacial till and glacial outwash. Plate 2 shows the transect lines for generalized hydrogeologic cross sections. Plates 3 and 4 present three generalized hydrogeologic cross-sections depicting the conditions beneath the Site, including:

- Section A-A' (Plate 3) oriented east-west, across the Site;
- Section B-B’ (Plate 4) oriented north-south, through the Site; and
- Section C-C’ (Plate 4) oriented north-south, along Newtown Creek.

A description of the various stratigraphic units is provided below.

8.1.1 *Artificial Fill*

The fill unit occurs at the surface throughout the Site, with a maximum observed thickness of approximately 20 feet. This fill unit is mostly the result of a history of land reclamation by multiple parties in support of the industrial development along Newtown Creek from the mid-1800s onward. The fill unit is generally thickest in those sections where the historical marshlands were filled prior to development and along the bank of Newtown Creek. The fill material consists of varying amounts of sand, gravel, silt, cobbles, brick, cinders, wood, metal, ash, concrete, and glass. Within the vicinity of Newtown Creek, the fill material, at times, is composed of a larger percentage of fine-grained material and clay, likely as a result of tidal action reworking the fill material.

8.1.2 *Historical Creek and Marsh Sediments*

Immediately underlying the fill material throughout the majority of the Site is a layer of fine-grained sediments. The areal extent of the fine-grained layer generally matches the areal extent of tidal salt marshes prior to development in the mid-nineteenth century as presented on Figure 6. Some of the key geographic features shown on Figure 6 are the much greater width of Newtown

Creek, as compared to its current configuration, and the significant extent of marshland along Newtown Creek, on both banks, for the majority of its length.

As shown in Figure 6, in 1844, a salt marsh, with an area of approximately 200 acres, existed throughout the Site and extended to the northwest of the Site. The southern border of this salt marsh generally corresponded with the southern border of the Site. Based on the available monitoring well and soil boring logs, the deposits of this tidal area typically consist of grey silty clay, with some organics/peat, in the vicinity of Newtown Creek and grade to a clayey/silt in the areas further away from Newtown Creek. Such deposits are consistent with the former presence of a salt marsh in this area. These fine-grained sediments form a layer that extends laterally into the base deposits of Newtown Creek. Where present, this layer typically ranges from 5 to 10 feet in thickness.

The historical creek and marsh sediment layer that overlies the glacial drift deposits is a significant hydrogeologic unit because, where present and competent, it acts as a semi-confining unit for the migration of both groundwater and potential LNAPL. In discussing the hydrogeologic framework, it is referred to as the shallow confining unit. This layer has a significant impact on historic and current potential LNAPL extents beneath the Site.

8.1.3 *Glacial Deposits*

Glacial deposits are present and continuous throughout the subsurface at the Site, as well as in the region surrounding the Site. In a regional hydrogeologic context, the saturated glacial deposits are referred to as the Upper Glacial Aquifer. As part of the EMGPRP, these saturated deposits have been, and will continue to be, referred to as the regional aquifer.

The glacial deposits are comprised of both outwash deposits and till. At locations where both types of deposits are present, the outwash deposits usually overlie the till. The outwash deposits are typically well-sorted sand deposits, with occasional silt/clay layers, while the till is typically a dense, poorly-sorted deposit, consisting of varying amounts of sand, silt, clay, gravel, and cobbles.

The areal extent and thickness of outwash deposits increases in a southerly direction across the Site. Glacial till, where present, is characterized by a significantly lower hydraulic conductivity than the

outwash sediments and, therefore, acts as a confining or semi-confining unit to groundwater and potential LNAPL.

The distribution of glacial outwash deposits and till is important because the outwash deposits of the regional aquifer are characterized by a significantly larger transmissivity than the glacial till; therefore, groundwater and potential LNAPL would tend to reside within and preferentially migrate through the outwash deposits.

8.1.4 *Bedrock*

Based on regional geologic literature, beneath the unconsolidated deposits is pre-Cambrian aged bedrock. The regional literature and USGS well records indicate that the depth to bedrock increases in a southerly direction across the Site in direct correlation with the increasing thickness of the glacial deposits described above. Records of USGS monitoring wells indicate that bedrock surface elevation is approximately 75 feet below mean sea level (ft bmsl) at the intersection of Greenpoint Avenue and Newtown Creek. The bedrock surface elevation is greater than 150 ft bmsl in the area south of the Site. To date, bedrock has not been encountered during the installation of any of the monitoring or recovery wells installed on behalf of ExxonMobil.

8.2 Hydrogeologic Units

The foregoing stratigraphic units underlying the Site form three distinct hydrogeologic units that are significant to the investigation and remediation activities at the Site, including:

1. The shallow aquifer;
2. The shallow confining unit, and
3. The regional aquifer.

A description of each hydrogeologic unit is provided in the following sections.

8.2.1 *Shallow Aquifer*

The shallow, water-bearing zone that has been referred to during the EMGPRP as the shallow aquifer is primarily comprised of the saturated fill materials deposited above the historical creek and marsh sediments. Based upon this relationship, the areal extent of the shallow aquifer should generally correspond to the limits of the historical creek and marsh sediments as shown in Figure 6. Consistent with this information, the prior investigations have confirmed the entirety of the Site is underlain by the shallow aquifer.

The saturated thickness of the shallow aquifer is typically less than 10 feet. The hydraulic conductivity of this unit can vary widely over short distances due to the heterogeneity of the historical fill materials. The calculated hydraulic conductivity values for the shallow aquifer range from 0.64 to 84 feet per day (ft/day) (Roux Associates, 2009a). The highest hydraulic conductivity values are likely indicative of coarse fill material (i.e., mostly gravel, and varying amounts of medium to coarse sand, brick, and concrete). Excluding areas of very coarse fill (i.e., four monitoring well locations with the largest values of hydraulic conductivity), the average calculated hydraulic conductivity of the shallow aquifer is approximately 3.3 ft/day.

Groundwater elevations in the shallow aquifer appear to respond to precipitation events due to the limited thickness of the unit and the presence of the shallow, underlying, low permeability layer. As a result, the shallow aquifer has been characterized as exhibiting perched water-table characteristics. In addition, it is important to note that, despite being referred to by name as the "shallow aquifer," this unit has limited areal extent and thickness. As a result, the shallow aquifer does not meet the typical definition of an aquifer, in that it cannot yield water at sustained pumping rates typically required for water supply purposes.

8.2.2 *Shallow Confining Unit*

This unit corresponds to the historical creek and marsh sediments described in Section 8.1.2. As previously noted, the areal extent of the shallow confining unit generally corresponds to the depositional environment of the historical creek and marshland shown in Figure 6. The unit is typically between five and ten feet in thickness, and thins out inland, away from the ancestral marsh line and banks of Newtown Creek. The unit is characterized by very low hydraulic conductivity such that, where it is present and competent, it effectively isolates the shallow aquifer from the underlying regional aquifer and causes confined or semi-confined conditions within the

regional aquifer. A contour map of the elevations of the base of the shallow confining unit beneath the Site is provided on Figure 7. The SRSER (Roux Associates, 2011a) provides additional information outlining that the shallow and regional aquifers are separate units, and separated by the shallow confining unit.

The shallow confining unit is an important hydrogeologic unit because of its influence on LNAPL and groundwater migration, as well as corresponding recovery efforts. In addition, the shallow confining unit complicates the interpretation of LNAPL thickness measurements in monitoring wells because of an apparent exaggeration effect caused by the semi-confined conditions.

8.2.3 *Regional Aquifer*

The regional aquifer is comprised of the glacial deposits underlying the Site. In the northern portion of the Site, the low permeability, shallow semi-confining unit typically acts as an aquitard that separates the regional aquifer from the overlying shallow aquifer. The degree to which the regional aquifer is confined or semi-confined decreases as one moves south across the Historical Footprint. Beneath the Site the regional aquifer exists under confined or semi-confined conditions. The base of the shallow confining unit described above is present near or below sea level, confining the regional aquifer and causing the shallow aquifer to be formed above it.

Geologic boring logs indicate that the regional aquifer is composed primarily of fine to medium grained sands, with varying amounts of silt and coarser materials. Calculated hydraulic conductivity from slug tests performed in monitoring wells located within the regional aquifer beneath the Site range from 0.06 ft/day to 26 ft/day (Roux Associates, 2009a).

8.3 Groundwater Elevation and Flow Patterns

As indicated above, the regional aquifer is the primary water bearing unit beneath the Site and the surrounding area. The shallow aquifer has a saturated thickness typically less than 10 ft and is actually perched water.

Absent the influence of groundwater extraction activities, groundwater flow directions in the shallow aquifer and regional aquifer would generally be towards Newtown Creek. However,

groundwater extraction has been ongoing, and will continue for the duration of the current LNAPL recovery efforts. Current groundwater flow conditions are described below.

8.3.1 *Shallow Aquifer*

Groundwater flow in the shallow aquifer is depicted in Plate 5, based upon the results of the gauging event conducted on March 18, 2011. During this gauging event, the pumping influences on the shallow aquifer included the impact of the ongoing dewatering activities at the Newtown Creek WPCP (north of the Site). None of the EMGPRP remediation wells extract groundwater from the shallow aquifer.

As shown in Plate 5, groundwater flow across the eastern half of the Kingsland Yard parcel of the Site is generally to the east towards Newtown Creek, while groundwater flow across the rest of the Site is primarily north-northwest towards the ongoing dewatering project for the Newton Creek WPCP. Along the southern border of the Site groundwater flow in the shallow aquifer is currently to the south and southwest. In this area, the water table within the shallow aquifer is depressed by the operation of dual-pump recovery wells RW-17 and RW-18 located to the south of the Site. RW-17 and RW-18 are located in an area of semi/unconfined conditions, allowing a localized influence on the shallow aquifer beneath the southern portion of the Site. Prior to the operation of these recovery wells, the shallow aquifer groundwater flow direction was to the north and northeast, as shown in Figure 8.

8.3.2 *Regional Aquifer*

Groundwater flow in the regional aquifer is depicted in Plate 6, based on the March 18, 2011 gauging event. During this gauging round, 20 recovery wells were operating within the EMGPRP, extracting groundwater at a combined rate of approximately710 gallons per minute (gpm). In addition, BP Terminal recovery wells and former Paragon Oil Terminal recovery wells were extracting groundwater at approximate rates of 44 and 20 gpm as of November 2010, respectively.

The potentiometric surface and inferred groundwater flow directions in the regional aquifer under pumping conditions exhibit multiple directional components within the site.

- Throughout a majority of the remainder of the Site, the groundwater flow direction along the western boundary of the Site is consistent with the regional flow pattern. The groundwater flow direction within the central portions of the Site is predominantly controlled by the dewatering efforts of the EMGPRP, with groundwater flow typically orientated towards one of the nearest recovery wells.

- Along the eastern boundary of the Site there is a component of the groundwater flow direction that is generally towards Newtown Creek.
- Dewatering efforts completed by BP, NYCDEP and Chevron, respectively, alter the groundwater flow direction in these areas.

8.3.2.1 *Regional Aquifer Tidal Fluctuations*

Tidal fluctuation of surface water levels in Newtown Creek influence groundwater levels adjacent to the Creek, and these influences are observed in monitoring wells screened within the regional aquifer. Tidal fluctuations are typically not observed within shallow aquifer monitoring wells. The magnitude of the tidal influence on groundwater levels decreases with increasing distance from the Creek. In general, tidal influence is either not discernible or negligible at distances greater than 200 ft from Newtown Creek. Tidal influences are important within the context of the Site Conceptual Model (SCM) because the changes in groundwater levels affect groundwater and LNAPL migration, as well as the effectiveness of various recovery technologies.

8.3.3 *Historical Regional Groundwater Pumping Effects*

Brooklyn, as well as almost all of New York City, currently receives potable water from upstate New York reservoirs via an aqueduct system. However, Brooklyn once depended exclusively on groundwater for both industrial and public water supply. The historical operations of industrial and public water supply pumping wells in the borough of Brooklyn had a significant impact on regional and site-specific groundwater conditions (Geraghty and Miller, 1979; Buxton *et al.*, 1981).

At the beginning of the Twentieth Century, groundwater pumping rapidly escalated in response to rapid industrial and residential development while, at the same time, aquifer recharge was significantly reduced due to the reduction in stormwater infiltration area from urban development. Groundwater withdrawal from the regional aquifer was so extensive that, in combination with reduced aquifer recharge capacity, the water table throughout the entire borough of Brooklyn became significantly depressed. By the mid-1930s, the water table in the center of this cone of depression was approximately 35 feet below mean sea level (Buxton *et al.*, 1981). The center of this cone of depression was located only a few miles to the south of the Site.

The extensive groundwater pumping effectively reversed the direction of groundwater flow in most areas adjacent to major surface water bodies, including the Site. The reversal of flow resulted in the intrusion of saltwater from the adjacent surface water bodies into the regional aquifer and subsequent chloride contamination of Brooklyn's groundwater supply. By the 1940s, the substantial chloride contamination forced the closure and relocation of many public water supply wells (Buxton *et al.*, 1981). In 1947, all public water-supply groundwater pumping ceased in the borough of Brooklyn due to extensive chloride contamination and Brooklyn began depending exclusively on potable water supplied by the City's aqueduct system constructed in the 1920s. Although the water table began to recover following the cessation of pumping (Buxton *et al.*, 1981), it did not return to predevelopment levels until the 1970s. Historical sampling of groundwater at the site has documented the continued presence of high total dissolved solids, sodium and chloride levels, likely as a result of the former public water supply pumping.

9 *NATURE AND EXTENT (CURRENT UNDERSTANDING OF ENVIRONMENTAL CONDITIONS)*

9.1 Soil

- Soil Investigations ☒ Yes ☐ No
- Bank Samples ☐ Yes ☒ No

The following summary of soil quality is based on laboratory analytical data that were generated by Roux Associates during previous investigations conducted on behalf of ExxonMobil. A summary of sample locations and corresponding depth intervals is provided in Table 1 of the Soil Summary Report and Supplemental Work Plan (S-SRSWP) (Roux Associates, 2011c). A summary of laboratory analytical data is provided in Tables 2 through 12 of the S-SRSWP.

The soil laboratory analytical results from all investigations completed within the Site by Roux Associates, on behalf of ExxonMobil, were compared to NYSDEC Part 375 Restricted Industrial criteria, NYSDEC Part 375 Criteria for the Protection of Groundwater, and supplemental criteria presented in NYSDEC CP-51. Results of data comparison to these criteria are shown on Plates 13 through 16 of the S-SRSWP. A summary of all soil data collected within the as part of the EMGPRP is presented in Tables 2 through 7 of the S-SRSWP.

Summaries of TCLP results for constituents and other waste characterization parameters are provided in Tables 8 through 12 of the S-SRSWP, respectively. The spatial distribution of constituents within the Site and the magnitude of exceedance of these compounds compared to NYSDEC Part 375 Restricted Industrial and Protection of Groundwater standards are shown on Plates 7 through 10, respectively. Samples, for which exceedances of one or both of the regulatory standards were detected, are presented according to their distinct sample category (shallow unsaturated soil, deeper unsaturated soil, and saturated soil). A Site plan showing all soil sampling locations for which the respective chemical data are available is provided on each Plate.

The analytical results for soil samples were divided into the following three categories for data evaluation and presentation purposes: shallow unsaturated soil, deeper unsaturated soil, and saturated soil (note that on Plates 7 through 9 these zones are referred to as shallow, unsaturated and saturated, respectively). Plate 10 shows results for the shallow and unsaturated zone only, as PCBs sample data is not available for saturated soil. Shallow unsaturated soil samples were collected from below paved land surface (i.e., "top" equals depth below paved surface to a typical depth of approximately 3 ft-bls, depending on the thickness of the paved land surface. Deeper unsaturated soil samples were typically collected from the most impacted interval in the vadose zone between 3 ft-bls (i.e., "top" is greater than 3 ft-bls) and the water-table. Saturated soil samples were collected below the water-table.

9.2 Groundwater Investigations ☒ Yes ☐ No

The CSP provides a chronology of the major phases of investigation and remedial action that have occurred at the Site, as well as a summary of the objectives, scope of work and key findings for each phase of work. The focus of most of these prior investigations included the analysis of the potential LNAPL extent and migration characteristics, as well as hydrogeologic conditions and their potential influence on LNAPL accumulations. In addition, many of the investigations and remedial actions generated analytical data regarding groundwater conditions.

Plate 1 shows the locations of CPT borings and monitoring wells that were advanced and/or installed as part of the EMGPRP. A list of investigations and monitoring activities that generated analytical data or other information relevant to the evaluation of groundwater quality within the Site is presented below:

- 2002 and 2003: Investigations of the Former Brooklyn Terminal and Former Refinery Properties (Roux Associates)
- 2007: Former Brooklyn Terminal Post Demolition Site Assessment (Roux Associates)
- 2007-2009: Former Brooklyn Terminal Comprehensive Site Investigation (Roux Associates)
- 2008-2010: Waterflooding Pilot Study (Roux Associates)
- Periodic Groundwater Sampling Events (Roux Associates)
  - Monthly Discharge Monitoring Report (DMR) Sampling of System Influent
  - Quarterly Performance Sampling of RCS Recovery Wells

The scope of work and results of each investigation were documented in the investigation summary reports submitted to the NYSDEC. A summary of each investigation is provided in the CSP.

9.2.1 NAPL Presence (Historical & Current) ☒ Yes ☐ No

The following sections describe the historical and current potential extent of potential LNAPL within the Site, as well as the potential composition of the potential LNAPL within various areas of the Site.

9.2.1.1 Potential LNAPL Occurrence and Migration

Numerous investigations have been conducted in an effort to delineate the extent of potential LNAPL, where present, beneath various portions of the Site. During the course of these investigations, recovery of potential LNAPL has also been conducted on an ongoing basis in various portions of the Site. During the development of the CAP (Exhibit 2 to the Consent Decree), an evaluation of all of the historical investigation information was conducted and reviewed with the NYSDEC. The historical regional water-supply pumping and local stratigraphy (see Section 8.1) have both influenced the potential migration and distribution of potential LNAPL accumulations beneath the Site. The effects of each of these factors have been documented in multiple reports and are summarized below.

The existence of a depressed water table beneath the Site and Off-Site area south of the Site (the Off-Site Area), caused by pumping influences noted above, is believed to have allowed potential LNAPL to potentially migrate deeper within the aquifer(s) than it would have otherwise. In addition, the reversal of the hydraulic gradient due to the historical pumping caused the

preferential migration of potential LNAPL to the south, away from Newtown Creek, toward inland areas. The local stratigraphy also influenced this direction of migration. As described in Section 8.1.3, the outwash deposits that comprise the regional aquifer beneath Off-Site Area are orders of magnitude more permeable than the low permeability sediments associated with the historical banks of Newtown Creek, beneath the BP Terminal, the Apollo Street Parcels and the former Paragon Oil Terminal. The existence of the reversed gradient, coupled with the high hydraulic conductivity of the regional aquifer, resulted in the historical southward migration of potential LNAPL from the Historical Footprint into the Off-Site Area.

Geraghty and Miller (1979) noted that the operation records of several industrial wells present within the Off-Site Area, during the period of water-supply pumping, indicated that the groundwater elevations during this period ranged from approximately 5 to 13 ft bmsl. These elevations are generally consistent with the depth of the smear zone beneath this area, as delineated during prior investigations by Roux Associates (Roux Associates, 2011b).

As noted in Section 8.3.3, public water-supply pumping in Brooklyn ceased in 1947. Some industrial water-supply pumping continued for several years thereafter; however, by 1974, regional groundwater elevations appeared to have recovered to predevelopment (i.e., static) levels (Buxton *et al*, 1981). The return to static conditions within the regional aquifer restored the flow of groundwater within the Site towards Newtown Creek. The flow direction of potential LNAPL within areas of the Off-Site Area also changed in response to the new hydraulic gradient.

If there were no geologic barriers to LNAPL flow, one would expect that the 1978 seepage would have been discovered at the BP Terminal or at any point between the BP Terminal and the Meeker Avenue area (i.e., Empire Merchants), since this would have been the shortest and most direct flow path to Newtown Creek. However, the historical observations and data indicate that this was not the case. The preferential migration pathway to the northern terminus of Meeker Avenue is explained by the presence of the shallow confining unit, formed by the low permeability sediments associated with the historical banks of Newtown Creek located beneath the BP Terminal, the Apollo Street Parcels and the former Paragon Oil Terminal. The shallow confining unit constrained the flow of potential LNAPL and forced it to flow around this layer, through the highly permeable outwash deposits of the regional aquifer toward Meeker Avenue.

9.2.1.2 Current Extent of Potential LNAPL

The current extent of potential LNAPL beneath the Site is depicted in Plates 11 through 13. This extent is less than what was observed historically as a result of the remediation efforts completed to date at the Site. As noted in Section 8.2, the shallow aquifer and regional aquifer are two distinct geologic units beneath the Site. The current occurrence and distribution of potential LNAPL in each of these units is described below.

Shallow Aquifer

The LNAPL occurrence and apparent thickness in the shallow aquifer is depicted on Plate 11, based on data collected on March 18, 2011. As shown on Plate 11, LNAPL was observed in only 8 out of a total of 75 wells screened in the shallow aquifer. The wells with measurable LNAPL are dispersed throughout the Site.

Based upon the irregular occurrence and minor thicknesses (i.e., typically less than 0.2 foot based on previous gauging rounds) of potential LNAPL in monitoring wells, the potential LNAPL within the shallow aquifer appears to currently exist only within localized areas. The fluctuating appearance of discrete LNAPL accumulations in the shallow aquifer monitoring wells from one gauging round to the next is also not uncommon at sites with relatively low hydraulic conductivity and residual LNAPL characteristics, as those that exist beneath the Site.

Regional Aquifer

The current extent and measured apparent thicknesses of potential LNAPL accumulations within the regional aquifer are shown on Plate 12, based on data collected on March 18, 2011. The extent of corrected LNAPL accumulations within the regional aquifer are shown on Plate 13, based on data collected on March 18, 2011. The current extent of potential LNAPL accumulations is influenced by the previously described Site stratigraphic controls, as well as the ongoing groundwater extraction and LNAPL recovery efforts.

Based on current data, the accumulations of potential LNAPL beneath the site are irregularly shaped and are present in the southeastern portions of Kingsland Yard and Monitor Yard of. The irregular boundaries of the LNAPL accumulations within the regional aquifer appear to be attributed to the shallow confining unit generally preventing LNAPL migration to the north, west, and east in these areas. In addition, low permeability glacial till deposits beneath the North

Henry Yard and the western portion of Monitor Yard limit the westward migration of potential LNAPL within the regional aquifer at the Site. The morphology of these low-permeability layers is discussed in the 2009 Comprehensive Site Investigation Report (Roux Associates, 2009a).

9.2.1.3 Current Apparent LNAPL Thicknesses in the Regional Aquifer

Apparent LNAPL thicknesses have been historically measured in all monitoring wells on a quarterly basis. As documented in prior reports and the published technical literature, LNAPL thickness measurements in monitoring wells are influenced by many different factors, including, but not limited to, the type and amount of LNAPL in the subsurface, formation pressures (i.e., specifically in confined and/or semi-confined formations), and the type of geologic formation materials, as well as capillary interactions between the formation and pore fluids.

A discussion of the factors that influence LNAPL thickness is presented in Section 4.3.1.3 of the CSP (Roux Associates, 2012) and also in Section 3.1 of the SRSER (Roux Associates, 2011a).

Plate 12 presents the current apparent LNAPL thicknesses for the regional aquifer based upon the gauging round conducted on March 18, 2011. The maximum measured and highest average measured thicknesses correspond to areas of the Site where potential LNAPL within the regional aquifer exists under confined conditions. The high apparent LNAPL thicknesses in this area do not equate to the presence of a greater volume of potential LNAPL, but are exaggerated thicknesses attributed primarily to confining pressures within the formation. Comparing the elevations of the oil-water interface with the bottom of the confining layer that exists in the Site indicates that the zone of mobile LNAPL is typically less than four feet in thickness.

9.2.3 Groundwater Seep Observations ☐Yes ☒ No

No groundwater seeps have been identified at the Site.

9.2.4 Groundwater Summary

The most recent groundwater data available for each sampling locations within the Site are summarized in Tables 3 through 8 of the Groundwater Summary Report and Supplemental Work Plan (GW-SRSWP, Roux Associates, 2011b). Due to the large amount of data that were

generated Site-wide, the tables do not include historic data. The distribution of various constituents within the Site is shown on Plates 14 through 23 and Figures 9 through 13.

A summary of potential data gaps identified for different areas of the Site based on historical data evaluation, and a supplemental investigation work plan designed in an attempt to fill these potential data gaps, has been provided to the NYSDEC in the Groundwater Summary Report and Supplemental Work Plan (Roux Associates, 2011b) and is pending NYSDEC approval.

9.3 Surface Water

Surface Water Investigation	☐ Yes	☒ No
General or Individual Stormwater Permit (Current or Past)	☒ Yes	☐ No
Do other non-stormwater wastes discharge to the system?	☒ Yes	☐ No
Stormwater Data	☒ Yes	☐ No
Catch Basin Solids Data	☐ Yes	☒ No
Wastewater Permit	☒ Yes	☐ No

NYSDEC SPDES Permit

SPDES Permit # - NY 000 4995

Original 2/1/1996

Modified 12/8/1998

Renewed 2/01/2001

SPDES Equivalence 9/2005

Combined under new SPDES Permit # - NY 026 7724

SPDES Permit # - NY 026 7724

Original - 4/1/2008

Modified – 9/24/2010

Expires – 3/31/2013

Current SPDES (NY 026 7724) discharge limits:

Parameter	Units	Outfall 01A Daily Max	Outfall 01 Daily Max
Flow	MGD	0.932	Monitor
pH[7]	S.U.	6.5 - 8.5	6.5 - 8.5
Oil & Grease	mg/L	15	15
Total Suspended Solids	mg/L	40	40
System Turbidity (Influent / Discharge Pipe)			Monitor
Turbidity (Receiving Water Background)			Monitor
Settleable Solids	mL/L	0.1	
1,1-Dichloroethane	µg/L	10	
1,2-Dichloroethane	µg/L	10	
Benzene	µg/L	10	
Copper	µg/L	95	
Ethylbenzene	µg/L	5	
Mercury	µg/L	Monitor	
Methyl-tert-butyl ether	µg/L	50	
Naphthalene	µg/L	20	
Phenols	µg/L	Monitor	
Tetrachloroethylene	µg/L	10	
Toluene	µg/L	5	
Trichloroethylene	µg/L	10	

Parameter	Units	Outfall 01A Daily Max	Outfall 01 Daily Max
Vinyl chloride	µg/L	10	
Xylenes (Total)	µg/L	10	

Wastewater Data ☒ Yes ☐ No

Report Date	Constituent	Result	Unit	Limit	Notes
3/11/2009	Benzene	18.5	µg/L	10	RCS Outfall 001A
	Toluene	22.9	µg/L	5	
	Xylenes (total)	38.7	µg/L	10	

No surface water investigations have been completed in association with the EMGPRP.

9.4 Sediment

Creek Sediment Data ☐ Yes ☒ No

No sediment investigations have been completed associated with the EMGPRP.

9.5 Air

Air Permit ☐ Yes ☒ No

Air Data ☒ Yes ☐ No

The following air pollution control equipment is currently operated at the Site facilities to control VOCs and/or methane air emissions from remediation processes prior to discharge to the atmosphere:

- RCS (400 Kingsland Avenue)
  Air stripper off-gas is treated using two-stage granular activated carbon (GAC) beds.

In email correspondence dated March 23, 2010, the NYSDEC stated that these air emissions are exempt from registration provisions under 6 NYCRR Part 201-3.3 [specifically 201-3.3 (28) & (29)]. ExxonMobil complies with the provisions in Part 201-3.3(a) and (b) and provides updates on system operation and/or modification via the Quarterly Progress Reports submitted to the NYSDEC for remedial activities, including, but not limited to, the submission of analytical data for influent and effluent samples for each air emission facility.

10 REMEDIATION HISTORY (INTERIM REMEDIAL MEASURES AND OTHER CLEANUPS)

The primary remediation activities at the Site have been LNAPL recovery and groundwater extraction and treatment. In addition, remedial actions have been conducted in an effort to address removal of soil, removal of underground piping and soil vapor mitigation within various

portions of the Site, where appropriate. A summary of previous and ongoing remediation activities is provided below.

10.1 Summary of Historical Potential LNAPL Recovery

LNAPL recovery at the Site has been conducted by ExxonMobil on an ongoing basis since 1978. In addition, LNAPL recovery has been conducted by BP at the adjacent BP Terminal and by Chevron at the Former Paragon Terminal. Collectively, a total of approximately 11,802,735 gallons of LNAPL have been recovered by the efforts of the ExxonMobil, BP, and Chevron, as of December 31, 2011. Figure 14 provides a graphical depiction of cumulative LNAPL recovery from 1979 through 2010, and divides the LNAPL recovery efforts into the following categories:

- The Meeker Avenue Task Force;
- ExxonMobil Recovery (ORS and RCS);
- BP Recovery; and
- Former Paragon Oil Terminal Recovery.

Figure 4 shows the location of the SVE system and active soil vapor extraction wells. Figure 5 shows the locations of the current active recovery wells that are operating as part of these systems. The recovery efforts that were completed on behalf of ExxonMobil are summarized in the following sections.

10.1.1 Meeker Avenue Task Force

Following the September 1978 discovery of free-product seepage into Newtown Creek, four free-product recovery sumps were installed at the foot of Meeker Avenue within OU-8 and the eastern corner of the former Paragon Oil Terminal. Recovery operations at these sumps and along Newtown Creek were coordinated by the Meeker Avenue Task Force, a group organized to study and determine a course of corrective action for the seepage. The Meeker Avenue Task Force included representatives from Mobil, Amoco, American Petroleum Institute (API), the NYSDEC, FDNY, and the New York State Department of Transportation (NYSDOT). Cumulative LNAPL recovered during operation of the sumps from September 1978 to June 1979 amounted to 95,000 gallons (Geraghty and Miller, 1979).

A dual-pump free-product recovery system was installed at the end of Meeker Avenue in a new 24-inch diameter well in 1981 (Recovery Sump RW-1). This well was replaced by a 12-inch diameter

well in 1987 (Recovery Sump RW-2). In 1996, the designation of this well was changed to Recovery Well G when the well was incorporated into the ORS as described below. Approximately 302,941 gallons of LNAPL were recovered during the operation of the Meeker Avenue Task Force system from 1979 to 1989.

10.1.2 Off-Site Free-Product Recovery System

As shown in Figure 14, the largest portion of free-product recovery has occurred from the operation of the ORS. The ORS was designed and constructed based upon the conceptual plan presented in the 1991 Off-Site RAP (Roux Associates 1991b). Construction and implementation of the ORS entailed a multi-year effort for property access at multiple locations, as well as securing necessary permits and approvals for the construction project. Construction was completed and recovery operations began in October of 1995.

The ORS consists of a dual-pump free-product recovery well system, a water treatment system, and an outfall. Figure 3 shows the locations of the 11 recovery wells (i.e., RW-H through RW-L, and RW-21 through RW-26) as well as the water treatment plant (corner of Bridgewater Street and Meeker Avenue). A description of the expanded system currently in operation is provided in the Recovery System Evaluation Report (Roux Associates, 2010b). Approximately 5,849,339 gallons of LNAPL have been recovered during the operation of this system as of March 31, 2011.

10.1.3 Former Brooklyn Terminal Recovery Systems

Free-product recovery began at the Site in 1979. The following outlines the historical progression of the recovery efforts at the Site:

- As of 1979, the recovery infrastructure at the former Brooklyn Terminal included a four foot diameter recovery well (RW-1). One well point system was also installed in an attempt to remove LNAPL from the shallow aquifer beneath the Site.
- During 1979, five additional recovery wells (RW-2 through RW-6) were installed in an effort to enhance the recovery of LNAPL within the shallow aquifer beneath the Site.
- In 1980, four additional recovery wells were installed within the shallow aquifer (RW-8 through RW-11) (LBG, 1982).
- At the end of 1981, the recovery operation at six of the shallow recovery wells (RW-2, RW-5, RW-6, RW-9 RW-10, and RW-11) ceased after no measurable LNAPL was observed in the recovery wells and adjacent monitoring wells. Recovery wells RW-12 and RW-13 (RW-13 was formerly utilized for dewatering of the barge slip formerly located within the northeast corner of Kingsland Yard) were incorporated into the ongoing recovery effort.

- In 1985, the operation of recovery well RW-8 ceased and a new recovery well, RW-14, was installed within the southeastern portion of the property (LBG, 1991).
- In 1988, recovery well RW-15 was installed at the former loading rack area between North Henry Street and Monitor Street. Recovery well RW-4 was also replaced by RW-4R, which was screened in both aquifers, in an effort to increase the volume of LNAPL recovered from this location.
- In 1990, in response to the release from Tank 69, four sumps were installed. Due to lack of LNAPL within the area, the sumps were deactivated in 1998.
- In 1993, LBG installed recovery well RW-16 in an effort to increase free-product recovery within the central portion of Kingsland Yard.

Following the completion of the 2002-2003 investigation activities, Roux Associates designed and constructed an expansion of the former Brooklyn Terminal recovery system. This included the installation of two new dual-pump recovery wells (RW-17 and RW-18 located to the south of the Site), incorporation of existing recovery wells RW-14 and construction of an upgraded groundwater treatment facility. This new system became operational in 2005 and has been referred to as the RCS. Subsequently, Roux Associates added two additional recovery wells (RW-19 and RW-20) to the RCS in 2006 and 2007, respectively. The RCS remains in operation. A description of the system is provided in the Recovery System Evaluation Report (RSER) (Roux Associates, 2010b).

In preparation for a water-flooding pressure-pulse pilot study conducted at the Site, historical recovery wells RW-3, RW-4, RW-4R, and RW-12 were decommissioned ,with approval from the NYSDEC, on July 7 through 9, 2008. All of these recovery wells had been inactive for several years due to the absence of recoverable amounts of LNAPL in their vicinity. In addition, these recovery wells were screened within both the shallow and the regional aquifer, which presents a potential pathway for the migration of LNAPL. The recovery wells were decommissioned, following approval of the NYSDEC, to eliminate the potential of upward-product migration during the water-flooding pilot study activities.

Approximately 1,206,590 gallons of LNAPL have been recovered during the operation of the RCS .

10.1.4 Underground Pipe Removal

Petroleum products remaining in the non-active pipelines can represent a potential source of impact to surrounding soil and groundwater. Removal of the lines, and any LNAPL contained within them,

are part of the source removal activities at the Site. The procedure for the underground piping excavation activities was outlined in the February 2008 Site Investigation Report for Kingsland Yard (Roux Associates, 2008). The work entails:

- Identification and location of abandoned underground process piping using historical maps and aerial photographs, as well as a geophysical survey;
- Removal of underground process piping; and
- Documentation of all pipe removal activities.

Throughout the entire Site, a total of approximately 104,373 ft of subsurface piping were removed. A total of approximately 8,327 gallons of LNAPL were recovered from the piping and/or excavations during the course of the project. Summaries updating the progress of the underground piping excavation activities were included in the quarterly monitoring reports that are submitted to the NYSDEC. A summary report documenting the completion of the underground piping excavation within Kingsland Yard was submitted to the NYSDEC on February 17, 2010 (Roux Associates, 2010c) and a final IRM Closure Report will be submitted to the NYSDEC in June of 2012.

10.1.5 Soil Vapor Mitigation System

A soil vapor mitigation system was constructed by ExxonMobil in an effort to mitigate elevated concentrations of methane and VOCs in shallow soil vapor (i.e., less than eight feet depth below the land surface) within the commercial/industrial area to the south of the Site (the Off-Site Area). The soil vapor mitigation consists of a soil vapor extraction system of seven (7) existing SVE wells (SVE-3, SVE-4, and SVE-6 through SVE-10), underground interconnecting piping, and a treatment facility located at 38 Varick Street in Greenpoint, Brooklyn, New York (38 Varick Street).

In addition to mitigating the methane and other VOCs in the shallow soil vapor, the SVE treatment facility is also used to treat the air stripper off-gas from the existing ORS groundwater treatment facility located at 5 Bridgewater Street in Greenpoint, Brooklyn, New York.

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Table 1

Potential Areas of Concern and Transport Pathways Assessment – ExxonMobil Greenpoint Petroleum Remediation Project

Potential Areas of Concern	Media Impacted					COPCs														Potential Complete Pathway*					
						TPH			VOCs																	
Description of Areas of Concern	Surface Soil	Subsurface Soil	Groundwater	Catch Basin Solids	River Sediment	Gasoline-Range	Diesel – Range	Heavier – Range	Petroleum Related (e.g., BTEX)	VOCs	Chlorinated VOCs	SVOCs	PAHs	Phthalates	Phenolics	Metals	PCBs	Herbicides and Pesticides	Dioxins/Furans	Overland Transport	Groundwater	Direct Discharge – Overwater	Direct Discharge – Storm/Wastewater	Discharge to Sewer/CSO	Bank Erosion
Site	√	√	√	?	--	√	√	√	√	√	√	√	√	√	√	√	√	√	?	--	√	--	√	--	--

Notes:
√ - COPCs are/were present in Areas of Concern having a current or historical pathway that is determined to be complete or potentially complete
? - There is not enough information to determine if COPC is/was present in Area of Concern or if pathway is complete
-- - Current or historical pathway has been investigated and shown to be not present or incomplete
* . The table above presents information with respect to the designation of Potential Complete Pathway for historical conditions. Currently, all pathways on the site are incomplete.
COPCs – Constituents of Potential Concern
BTEX - Benzene, toluene, ethylbenzene, and xylenes
PAHs - Polycyclic aromatic hydrocarbons SVOCs - Semi- volatile Organic Compounds TPH - Total Petroleum Hydrocarbons
VOCs - Volatile Organic Compounds

Table 2. Statistical Data for Soil, Former ExxonMobil Brooklyn Terminal, Greenpoint, Brooklyn, New York

Shallow Soil Data	Number of Samples	Number of Detections	Minimum Concentration	Maximum Concentration
Volatile Organic Compounds (µg/kg)				
1,2-Dichloroethene (total)	61	3	2	28
2-Butanone (MEK)	218	12	8	87
2-Hexanone	218	1	5	5
4-Methyl-2-pentanone (MIBK)	218	8	3	11
Acetone	218	69	6	685
Benzene	218	56	0	4960
Carbon disulfide	218	42	1	111
cis-1,2-Dichloroethene	218	2	2	14
Ethylbenzene	218	75	1	96000
Methylene chloride	218	21	1	14
MTBE	218	11	1	34
Styrene	218	1	11	11
Tetrachloroethene	218	4	1	11
Toluene	218	91	1	1990
Trichloroethene	218	8	1	220
Vinyl chloride	218	1	4	4
Xylenes (total)	218	91	1	25900
Semivolatile Organic Compounds (µg/kg)				
1,2-Dichlorobenzene	217	1	443	443
2,4-Dimethylphenol	217	2	98	757
2-Methylnaphthalene	217	91	27	151000
2-Methylphenol	217	2	66	502
3&4-Methylphenol	217	3	62	1450
4-Nitroaniline	217	1	890	890
Acenaphthene	217	94	12	33800
Acenaphthylene	217	88	8	15500
Anthracene	217	105	25	47200
Benzo[a]anthracene	217	130	18	129000
Benzo[a]pyrene	217	130	15	55700
Benzo[b]fluoranthene	217	126	25	123000
Benzo[g,h,i]perylene	217	128	33	93600
Benzo[k]fluoranthene	217	121	18	115000
Bis(2-ethylhexyl) phthalate	217	89	45	15100
Butylbenzyl phthalate	217	21	44	3450
Carbazole	217	74	14	26700
Chrysene	217	131	20	159000
Dibenzo[a,h]anthracene	217	114	10	17400
Dibenzofuran	217	69	13	17300
Diethyl phthalate	217	1	54	54
Dimethyl phthalate	217	1	2170	2170
Di-n-butyl phthalate	217	16	30	5740
Di-n-octyl phthalate	217	9	52	2370
Fluoranthene	217	128	20	158000
Fluorene	217	95	10	25400
Hexachlorobenzene	217	1	73	73
Hexachlorobutadiene	217	1	73	73
Hexachlorocyclopentadiene	217	1	730	730
Indeno[1,2,3-cd]pyrene	217	120	31	85600
Naphthalene	217	90	12	44400
n-Nitrosodiphenylamine	219	2	33	265
Phenanthrene	217	128	23	168000
Phenol	217	3	39	910
Pyrene	217	132	27	161000

Table 2. Statistical Data for Soil, Former ExxonMobil Brooklyn Terminal, Greenpoint, Brooklyn, New York

Shallow Soil Data	Number of Samples	Number of Detections	Minimum Concentration	Maximum Concentration
Metals (mg/kg)				
Aluminum	217	139	203	18800
Antimony	217	21	2	19
Arsenic	217	131	2	210
Barium	217	129	20	1300
Beryllium	217	23	1	8
Cadmium	217	70	1	10
Calcium	217	135	907	119000
Chromium	217	139	2	442
Cobalt	217	73	5	88
Copper	217	139	3	1320
Iron	217	139	1700	101000
Lead	217	137	3	13000
Magnesium	217	128	582	42000
Manganese	217	139	22	905
Mercury	217	126	0	11
Nickel	217	135	5	514
Potassium	217	51	1000	3890
Selenium	217	13	2	7
Silver	217	8	1	3
Sodium	217	6	1000	1200
Vanadium	217	135	5	327
Zinc	217	139	4	3760
TPH (mg/kg)				
Total Petroleum Hydrocarbons	217	136	31	20900

µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram

Table 2. Statistical Data for Soil, Former ExxonMobil Brooklyn Terminal, Greenpoint, Brooklyn, New York

Unsaturated Soil Data	Number of Samples	Number of Detections	Minimum Concentration	Maximum Concentration
Volatile Organic Compounds (µg/kg)				
1,2-Dichloroethene (total)	63	3	2	200
2-Butanone (MEK)	225	16	7	390
4-Methyl-2-pentanone (MIBK)	220	10	3	14
Acetone	220	71	7	1380
Benzene	225	84	1	25100
Carbon disulfide	220	59	1	1590
Chlorobenzene	225	1	77	77
cis-1,2-Dichloroethene	220	4	2	195
Ethylbenzene	220	97	1	666000
Methylene chloride	220	12	1	166
MTBE	220	11	0	57
Tetrachloroethene	225	4	3	34
Toluene	220	108	1	409000
trans-1,2-Dichloroethene	220	1	5	5
Trichloroethene	225	5	1	286
Xylenes (total)	220	122	1	4050000
Semivolatile Organic Compounds (µg/kg)				
1,2-Dichlorobenzene	220	1	335	335
2,4-Dimethylphenol	220	3	567	7300
2-Methylnaphthalene	222	104	31	250000
2-Methylphenol	225	4	488	11500
3&4-Methylphenol	225	3	272	8050
Acenaphthene	220	96	14	11900
Acenaphthylene	220	43	9	4290
Anthracene	222	114	18	14800
Benzo[a]anthracene	220	135	17	40200
Benzo[a]pyrene	220	131	18	24700
Benzo[b]fluoranthene	220	129	26	26500
Benzo[g,h,i]perylene	220	134	26	21600
Benzo[k]fluoranthene	220	116	20	25000
Benzoic Acid	15	2	883	950
Bis(2-ethylhexyl) phthalate	220	56	40	5150
Butylbenzyl phthalate	220	13	49	3450
Carbazole	222	45	20	3270
Chrysene	220	135	16	45600
Dibenzo[a,h]anthracene	222	114	14	11700
Dibenzofuran	222	89	14	14100
Diethyl phthalate	220	1	106	106
Di-n-butyl phthalate	220	4	61	606
Di-n-octyl phthalate	220	6	73	815
Fluoranthene	222	132	19	113000
Fluorene	222	116	11	27200
Indeno[1,2,3-cd]pyrene	220	110	29	18200
Naphthalene	220	84	10	212000
n-Nitrosodiphenylamine	220	2	405	2110
Phenanthrene	220	137	14	184000
Phenol	220	4	96	7790
Pyrene	220	139	14	142000

Table 2. Statistical Data for Soil, Former ExxonMobil Brooklyn Terminal, Greenpoint, Brooklyn, New York

Unsaturated Soil Data	Number of Samples	Number of Detections	Minimum Concentration	Maximum Concentration
Metals (mg/kg)				
Aluminum	220	140	485	16200
Antimony	220	18	2	26
Arsenic	225	133	2	1230
Barium	225	134	23	1670
Beryllium	220	18	1	3
Cadmium	225	53	0	6
Calcium	220	138	660	240000
Chromium	225	142	3	949
Cobalt	220	62	5	73
Copper	220	141	3	1290
Iron	220	142	3360	214000
Lead	225	141	1	36000
Magnesium	220	129	615	58600
Manganese	220	142	29	3060
Mercury	225	125	0	339
Nickel	220	138	5	730
Potassium	220	40	1150	5030
Selenium	225	15	2	11
Silver	225	22	1	15
Sodium	220	8	1100	4190
Vanadium	220	140	6	4680
Zinc	220	142	5	1630
TPH (mg/kg)				
Total Petroleum Hydrocarbons	225	141	33	55600

µg/kg - micrograms per kilogram
mg/kg - milligrams per kilogram

Table 2. Statistical Data for Soil, Former ExxonMobil Brooklyn Terminal, Greenpoint, Brooklyn, New York

Saturated Soil Data	Number of Samples	Number of Detections	Minimum Concentration	Maximum Concentration
Volatile Organic Compounds (µg/kg)				
1,2-Dichloroethene (total)	31	1	62	62
4-Methyl-2-pentanone (MIBK)	75	1	14	14
Acetone	75	12	9	403
Benzene	75	34	1	39500
Carbon disulfide	75	15	1	45
Chloroform	75	1	3	3
Chloromethane	75	1	132	132
cis-1,2-Dichloroethene	75	2	62	180
Ethylbenzene	75	33	1	17200
Methylene chloride	75	2	1	7
MTBE	75	4	1	421
Toluene	75	37	1	19100
Trichloroethene	75	2	7	173
Xylenes (total)	75	48	1	125000
Semivolatile Organic Compounds (µg/kg)				
2,4-Dimethylphenol	75	1	1790	1790
2-Methylnaphthalene	75	26	100	237000
Acenaphthene	75	43	59	16200
Acenaphthylene	75	4	32	2460
Anthracene	75	45	41	12300
Benzo[a]anthracene	75	52	24	25400
Benzo[a]pyrene	75	49	59	19400
Benzo[b]fluoranthene	75	45	73	8080
Benzo[g,h,i]perylene	75	47	56	10800
Benzo[k]fluoranthene	75	38	37	4600
Bis(2-ethylhexyl) phthalate	75	11	38	5210
Carbazole	75	9	61	1660
Chrysene	75	52	61	30800
Dibenzo[a,h]anthracene	75	41	26	5430
Dibenzofuran	75	29	29	9600
Diethyl phthalate	75	1	724	724
Fluoranthene	75	49	33	15600
Fluorene	75	48	17	26800
Indeno[1,2,3-cd]pyrene	75	40	28	5080
Naphthalene	75	18	24	96500
n-Nitrosodiphenylamine	75	2	573	6720
Phenanthrene	75	52	29	99600
Pyrene	75	52	61	34300

Table 2. Statistical Data for Soil, Former ExxonMobil Brooklyn Terminal, Greenpoint, Brooklyn, New York

Saturated Soil Data	Number of Samples	Number of Detections	Minimum Concentration	Maximum Concentration
Metals (mg/kg)				
Aluminum	75	51	1190	14800
Antimony	75	10	3	62
Arsenic	75	47	3	1310
Barium	75	47	24	2640
Cadmium	75	14	1	9
Calcium	75	52	630	159000
Chromium	75	53	5	115
Cobalt	75	22	6	22
Copper	75	53	5	1010
Iron	75	53	4230	129000
Lead	75	53	3	18100
Magnesium	75	42	621	10900
Manganese	75	53	19	684
Mercury	75	41	0	16
Nickel	75	52	6	353
Potassium	75	8	1390	8710
Selenium	75	11	3	9
Silver	75	5	1	5
Sodium	75	3	1300	1760
Vanadium	75	52	6	96
Zinc	75	53	11	4680
TPH (mg/kg)				
Total Petroleum Hydrocarbons	71	51	65	67900

µg/kg - micrograms per kilogram

mg/kg - milligrams per kilogram

Table 3. Statistical Data for Groundwater, Former ExxonMobil Brooklyn Terminal, Greenpoint, Brooklyn, New York

Shallow Aquifer Groundwater Data	Number of Samples	Number of Detections	Minimum Concentration	Maximum Concentration
Volatile Organic Compounds (µg/L)				
1,1-Dichloroethane	101	1	0.73	0.73
1,2-Dichloroethene (total)	78	11	0.52	9.6
2-Butanone (MEK)	101	5	3.4	110
4-Methyl-2-Pentanone (MIBK)	101	1	3	3
Acetone	101	43	3.3	131
Benzene	125	89	0.31	747
Bromochloromethane	4	1	0.31	0.31
Carbon disulfide	101	14	0.28	12.3
Chlorobenzene	101	3	0.59	1
Chloroethane	101	3	0.59	1
Chloroform	101	3	0.86	3.2
Chloromethane	101	5	0.61	0.85
cis-1,2-Dichloroethene	101	14	0.34	9.6
Cyclohexane	4	2	3.8	19.6
Ethylbenzene	125	63	0.3	240
Isopropylbenzene	4	4	5	55.3
m+p-Xylene	4	4	0.48	1.8
Methylcyclohexane	4	4	1.7	42.5
Methylene Chloride	101	2	1.6	1.8
MTBE	125	98	0.24	527
o-Xylene	4	4	0.33	0.76
Tetrachloroethene	101	1	0.35	0.35
Toluene	125	75	0.24	674
trans-1,2-Dichloroethene	101	1	0.58	0.58
Vinyl chloride	101	2	0.66	3.7
Xylenes (total)	125	90	0.4	914
Semivolatile Organic Compounds (µg/L)				
2,4-Dimethylphenol	118	12	2.4	48200
2-Methylnaphthalene	105	38	0.84	788
2-Methylphenol	105	5	3.4	16200
3&4-Methylphenol	105	4	9.8	5480
Acenaphthene	138	74	0.42	4900
Acenaphthylene	137	2	1.9	2.6
Anthracene	137	43	0.42	1300
Benzo[a]anthracene	137	72	0.41	5400
Benzo[a]pyrene	137	57	0.42	4400
Benzo[b]fluoranthene	137	42	0.5	2900
Benzo[g,h,i]perylene	137	48	0.44	3800
Benzo[k]fluoranthene	137	24	0.43	640
bis(2-Chloroethoxy)methane	137	1	1	1
Bis(2-ethylhexyl) phthalate	137	63	1	1000
Butylbenzyl phthalate	137	3	1	3.2
Carbazole	105	9	0.42	26.6
Chrysene	137	75	0.34	7900
Dibenzo[a,h]anthracene	137	25	0.73	1800
Dibenzofuran	105	38	0.5	17.3
Diethyl phthalate	137	3	1.8	17.3
Di-n-butyl phthalate	137	9	1.1	2200

Table 3. Statistical Data for Groundwater, Former ExxonMobil Brooklyn Terminal, Greenpoint, Brooklyn, New York

Shallow Aquifer Groundwater Data	Number of Samples	Number of Detections	Minimum Concentration	Maximum Concentration
Fluoranthene	137	56	0.37	2600
Fluorene	137	79	0.38	9900
Indeno[1,2,3-cd]pyrene	137	33	0.45	1900
Isophorone	137	2	0.98	1.5
Naphthalene	138	22	0.57	196
N-Nitrosodiphenylamine	137	1	3.1	3.1
Pentachlorophenol	125	1	2400	2400
Phenanthrene	137	69	0.47	164
Phenol	125	7	24.8	7000
Pyrene	129	81	0.38	790
Metals (µg/L)				
Aluminum	100	95	224	847000
Antimony	100	11	6.1	19.5
Arsenic	100	95	3.3	1920
Barium	100	31	203	6130
Beryllium	100	13	1	53.5
Cadmium	100	2	15.7	29
Calcium	100	100	26000	907000
Chromium	100	44	10.9	2650
Cobalt	100	1	778	778
Copper	100	76	10.6	2950
Iron	100	100	672	2910000
Lead	100	99	5.6	5260
Magnesium	100	97	5170	229000
Manganese	100	100	20.4	28800
Mercury	100	33	0.2	24.3
Nickel	100	25	10.1	1500
Potassium	100	83	10100	143000
Selenium	100	1	22.9	22.9
Sodium	100	100	15000	919000
Vanadium	100	14	53.4	2450
Zinc	100	93	22.1	9400

µg/L - micrograms per liter

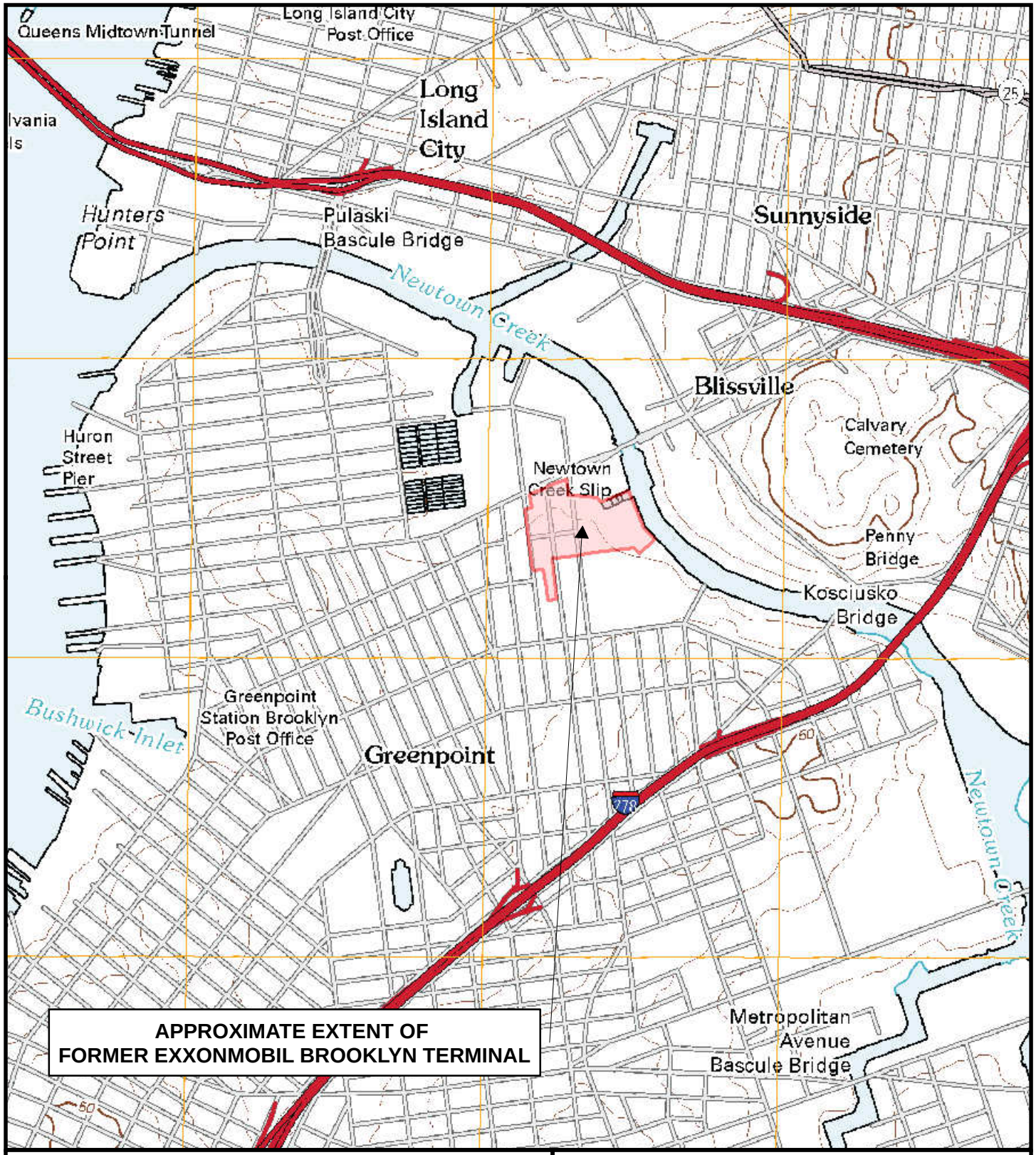
Table 3. Statistical Data for Groundwater, Former ExxonMobil Brooklyn Terminal, Greenpoint, Brooklyn, New York

Regional Aquifer Groundwater Data	Number of Samples	Number of Detections	Minimum Concentration	Maximum Concentration
Volatile Organic Compounds (µg/L)				
1,1-Dichloroethane	83	5	0.49	2.7
1,2,4-Trimethylbenzene	3	3	1.3	13
1,2-Dichloroethane	83	3	0.78	1.8
1,2-Dichloroethene (total)	68	5	0.86	19.3
1,3,5-Trimethylbenzene	3	3	0.37	4.8
2-Butanone (MEK)	83	2	4.1	6.1
4-Methyl-2-pentanone (MIBK)	83	1	7.1	7.1
Acetone	83	23	3.2	69.9
Benzene	85	38	0.24	3970
Bromodichloromethane	83	5	1.4	3.1
Carbon disulfide	80	13	0.22	1.5
Chloroform	83	18	0.54	35
Chloromethane	83	1	0.51	0.51
cis-1,2-Dichloroethene	83	6	0.86	19.3
Cyclohexane	5	1	5.8	5.8
Ethylbenzene	85	24	0.27	368
Isopropylbenzene	6	3	0.26	25.4
m+p-Xylene	6	4	0.64	67
Methylcyclohexane	3	1	88.7	88.7
Methylene chloride	83	6	0.37	4.4
MTBE	85	73	0.26	178
Naphthalene	3	3	1.1	4.2
n-Propylbenzene	3	1	1.9	1.9
o-Xylene	6	3	0.74	18.6
Toluene	85	31	0.25	2430
Vinyl chloride	83	7	0.33	16.8
Xylenes (total)	85	49	0.25	2110
Semivolatile Organic Compounds (µg/L)				
2,4-Dimethylphenol	83	3	318	801
2-Methylnaphthalene	83	15	0.69	25100
2-Methylphenol	83	4	1.2	188
3&4-Methylphenol	83	2	1.3	78.9
Acenaphthene	86	29	0.42	541
Acenaphthylene	85	1	29.9	29.9
Anthracene	85	17	0.5	469
Benzo[a]anthracene	85	33	0.42	493
Benzo[a]pyrene	85	26	0.58	425
Benzo[b]fluoranthene	85	25	0.66	327
Benzo[g,h,i]perylene	85	26	0.53	183
Benzo[k]fluoranthene	85	22	0.73	286
Bis(2-ethylhexyl) phthalate	85	36	1	144
Butylbenzyl phthalate	85	1	1	1
Carbazole	83	14	0.58	86.5
Chrysene	85	32	0.55	380
Dibenzo[a,h]anthracene	85	15	0.8	49.6
Dibenzofuran	83	9	0.7	180
Di-n-octyl phthalate	85	1	2.2	2.2
Fluoranthene	85	33	0.36	1350

Table 3. Statistical Data for Groundwater, Former ExxonMobil Brooklyn Terminal, Greenpoint, Brooklyn, New York

Regional Aquifer Groundwater Data	Number of Samples	Number of Detections	Minimum Concentration	Maximum Concentration
Fluorene	86	33	0.42	1790
Indeno[1,2,3-cd]pyrene	85	24	0.47	168
Naphthalene	85	15	0.45	3400
Phenanthrene	85	38	0.46	3440
Phenol	83	4	1	41.9
Pyrene	85	41	0.47	1350
Metals (µg/L)				
Aluminum	81	76	219	320000
Antimony	81	2	8.5	10.1
Arsenic	83	47	3	206
Barium	81	23	204	2590
Beryllium	81	17	1.2	35
Cadmium	83	10	3.1	47.6
Calcium	83	82	6630	829000
Chromium	83	39	10.4	993
Cobalt	83	5	74.1	106
Copper	83	48	14.9	852
Iron	83	83	202	878000
Lead	83	68	3.2	2590
Magnesium	83	79	5550	194000
Manganese	83	82	43.2	10700
Mercury	83	11	0.2	17.7
Nickel	83	27	10	770
Potassium	81	51	10100	663000
Selenium	81	1	13.5	13.5
Sodium	81	80	28000	1730000
Vanadium	83	18	53.6	1570
Zinc	83	64	22	2770

µg/L - micrograms per liter



QUADRANGLE LOCATION

SOURCE:
USGS, 2010
BROOKLYN QUADRANGLE; NEW YORK
7.5 MINUTE SERIES

1,000 0 1,000
Feet

Title:

SITE LOCATION MAP

EXXONMOBIL
GREENPOINT PETROLEUM REMEMDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For: EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: B.P.	Date: 14MAY2012	FIGURE
Prepared by: B.P.	Scale: 1:24,000	1
Project Mgr: C.P.	Project: 0172.0030Y030	
File No: 0172.0030E1875.101.MXD		

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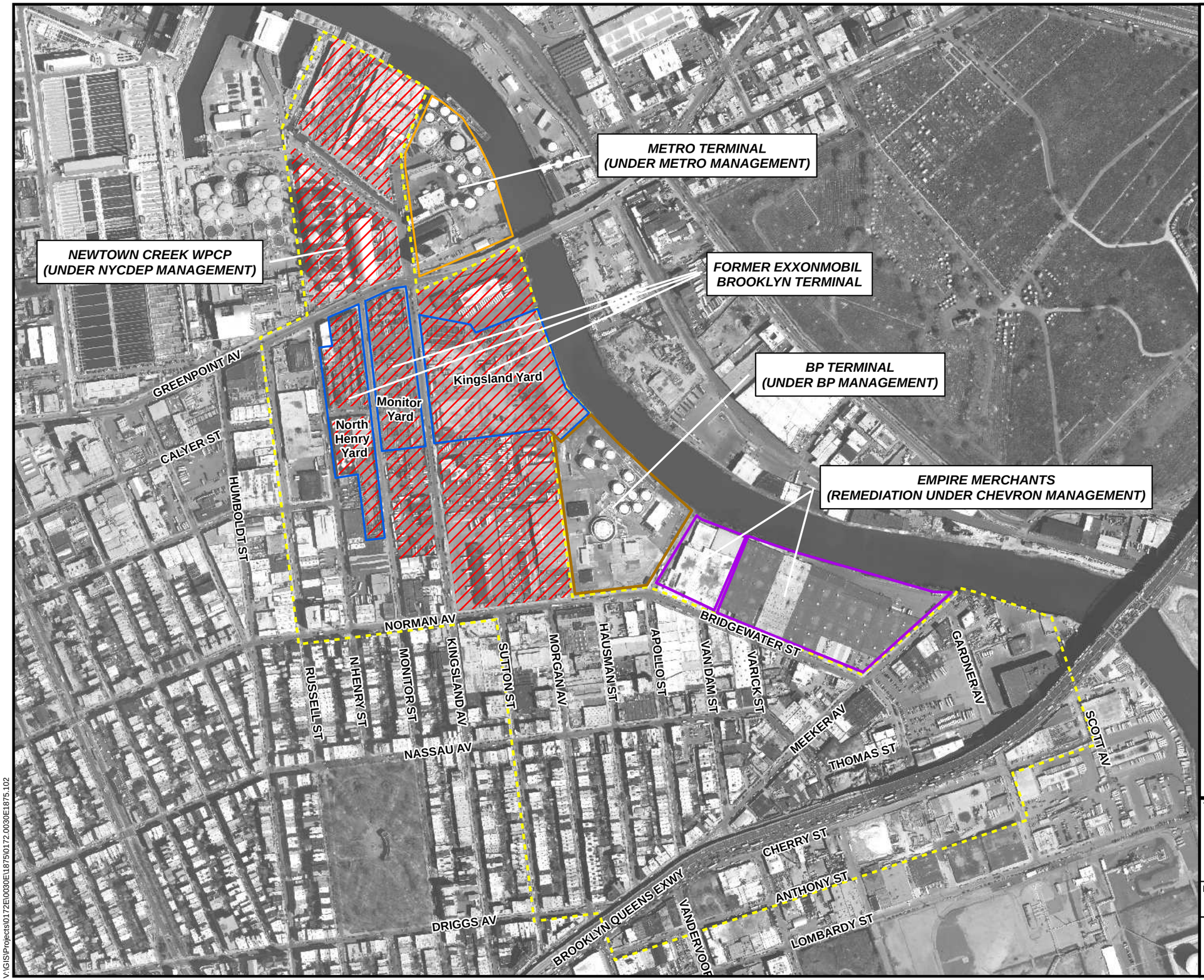

Legend

- NYSDEC Site Boundary
- Former ExxonMobil Refinery Extents
- Former ExxonMobil Brooklyn Terminal
- BP Terminal
- Empire Merchants
- Metro Terminal

N

500 0 Feet

Title:

SITE MAP

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For: EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: B.P.	Date: 14MAY2012	FIGURE 2
Prepared by: B.P.	Scale: 1:6,000	
Project Mgr: C.P.	Project: 0172.0030Y030	
File No: 0172.0030E1875.102.MXD		

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RECOVERY AND CONTAINMENT SYSTEM (RCS)

OFF-SITE FREE PRODUCT RECOVERY SYSTEM (ORS)

RW-20
RW-14
RW-18
RW-19
RW-17
RW-25
RW-26
RW-21
RW-E
RW-F
RW-H
RW-I
RW-D
RW-22
RW-23
RW-J
RW-24
RW-C
RW-A
RW-K
RW-L

GREENPOINT AV
CALYER ST
MESEROLE AV
NORMAN AV
BRIDGEWATER ST
NASSAU AV
DRIGGS AV
ANTHONY ST
HERBERT AV
TOWNSEND ST
THOMAS ST
CHERRY ST
BROOKLYN QUEENS EXPWY
GRANDY ST

Legend

- NYSDEC Site Boundary
- Active Dual-Pump Recovery Well Location
- Former ExxonMobil Brooklyn Terminal
- Groundwater Remediation System Piping
- Treatment System Location

N

500 0 Feet

Title:

EMGPRP RECOVERY SYSTEM SITE PLAN

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For: EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: B.P.	Date: 14MAY2012	FIGURE 3
Prepared by: B.P.	Scale: 1:6,000	
Project Mgr: C.P.	Project: 0172.0030Y030	
File No: 0172.0030E1875.104.MXD		

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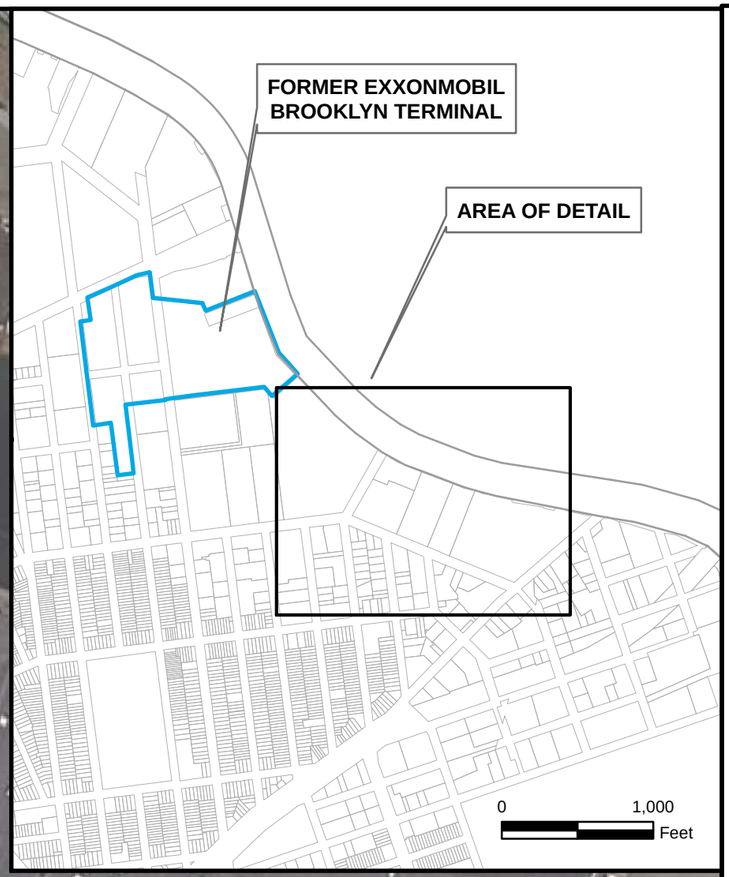
SOIL VAPOR EXTRACTION AND TREATMENT SYSTEM 38 VARICK STREET



Legend

- Soil Vapor Extraction Point
- Precautionary Soil Vapor Extraction Point
- SVE System Piping
- Precautionary SVE System Piping
- Soil Vapor Extraction and Treatment System

N

150 0 Feet

Title:

SOIL VAPOR EXTRACTION SYSTEM SITE PLAN

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For: EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX

ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: B.P.	Date: 14MAY2012	FIGURE 4
Prepared by: B.P.	Scale: 1 in = 150 ft	
Project Mgr: C.P.	Project: 0172.0030Y030	
File No: 0172.0030E1875.105.MXD		

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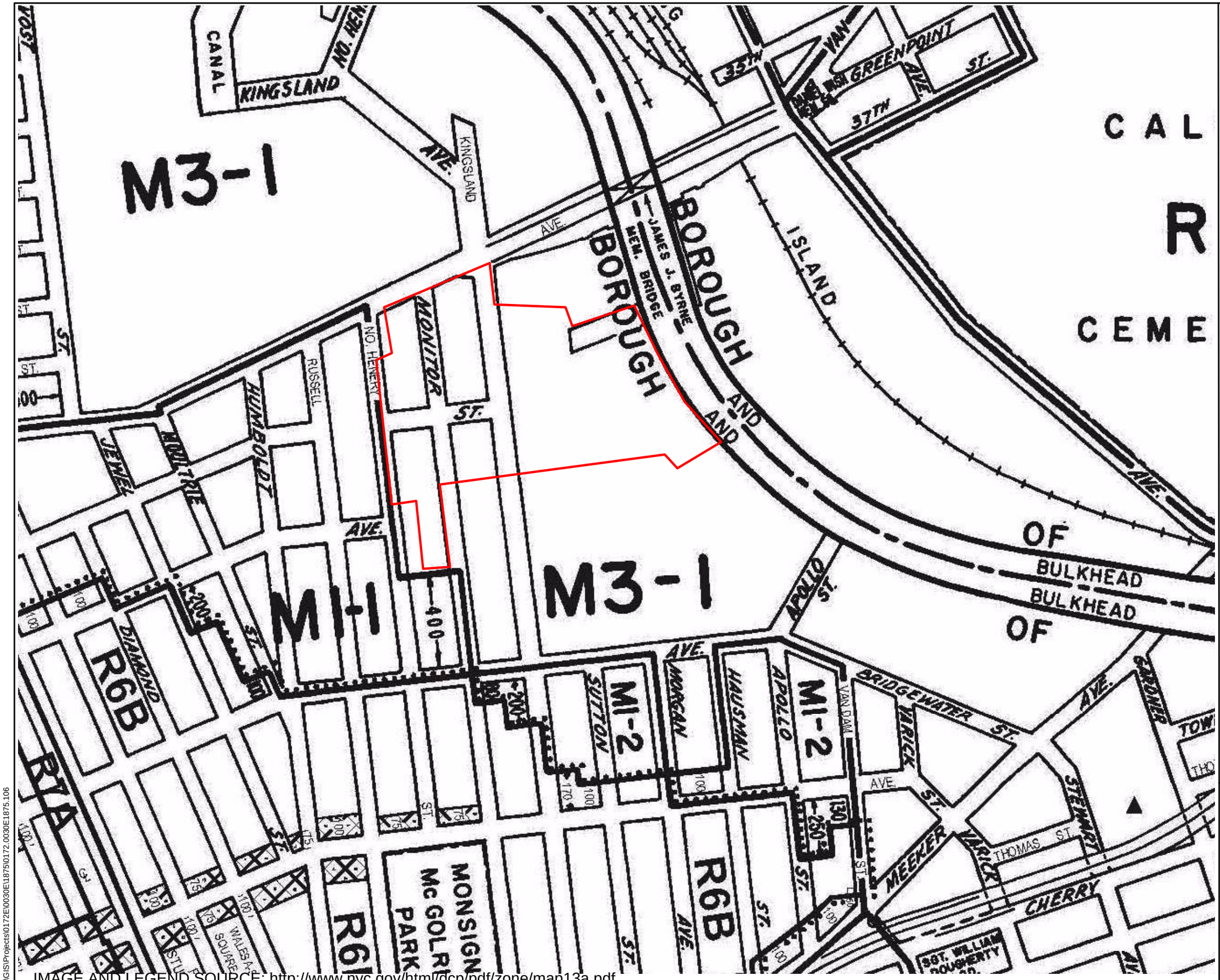

IMAGE AND LEGEND SOURCE: http://www.nyc.gov/html/dcp/pdf/zone/map13a.pdf

LEGEND

ZONING MAP

THE NEW YORK CITY PLANNING COMMISSION

Major Zoning Classifications:

The number(s) and/or letter(s) that follows an R, C or M District designation indicates use, bulk and other controls as described in the text of the Zoning Resolution.

R – RESIDENTIAL DISTRICT

C – COMMERCIAL DISTRICT

M – MANUFACTURING DISTRICT

SPECIAL PURPOSE DISTRICT
The letter(s) within the shaded area designates the special purpose district as described in the text of the Zoning Resolution.

AREA(S) REZONED

Effective Date(s) of Rezoning:

07–29–2009 C 090334 ZMK

Special Requirements:

For a list of lots subject to CEQR environmental requirements, see APPENDIX C.

For a list of lots subject to "D" restrictive declarations, see APPENDIX D.

For Inclusionary Housing designated areas on this map, see APPENDIX F.

CITY MAP CHANGE(S):

▲ 8–08–2009 C 030429 MMK

N

MAP KEY

8d	9b	9d
12c	**13a**	13c
12d	13b	13d

ZONING MAP 13a

NOTE: Zoning information as shown on this map is subject to change. For the most up-to-date zoning information for this map, visit the Zoning section of the Department of City Planning website: **www.nyc.gov/planning** or contact the Zoning Information Desk at (212) 720-3291.

Former ExxonMobil Brooklyn Terminal

Title:

ZONING MAP
NEW YORK CITY PLANNING COMMISSION
ZONE 13 a

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: B.P.	Date: 15MAY2012	FIGURE
Prepared by: B.P.	Scale: 1" = 100'	5
Project Mgr: C.P.	Project: 0172.0030Y030	
File No: 0172.0030E1875.106.wor		

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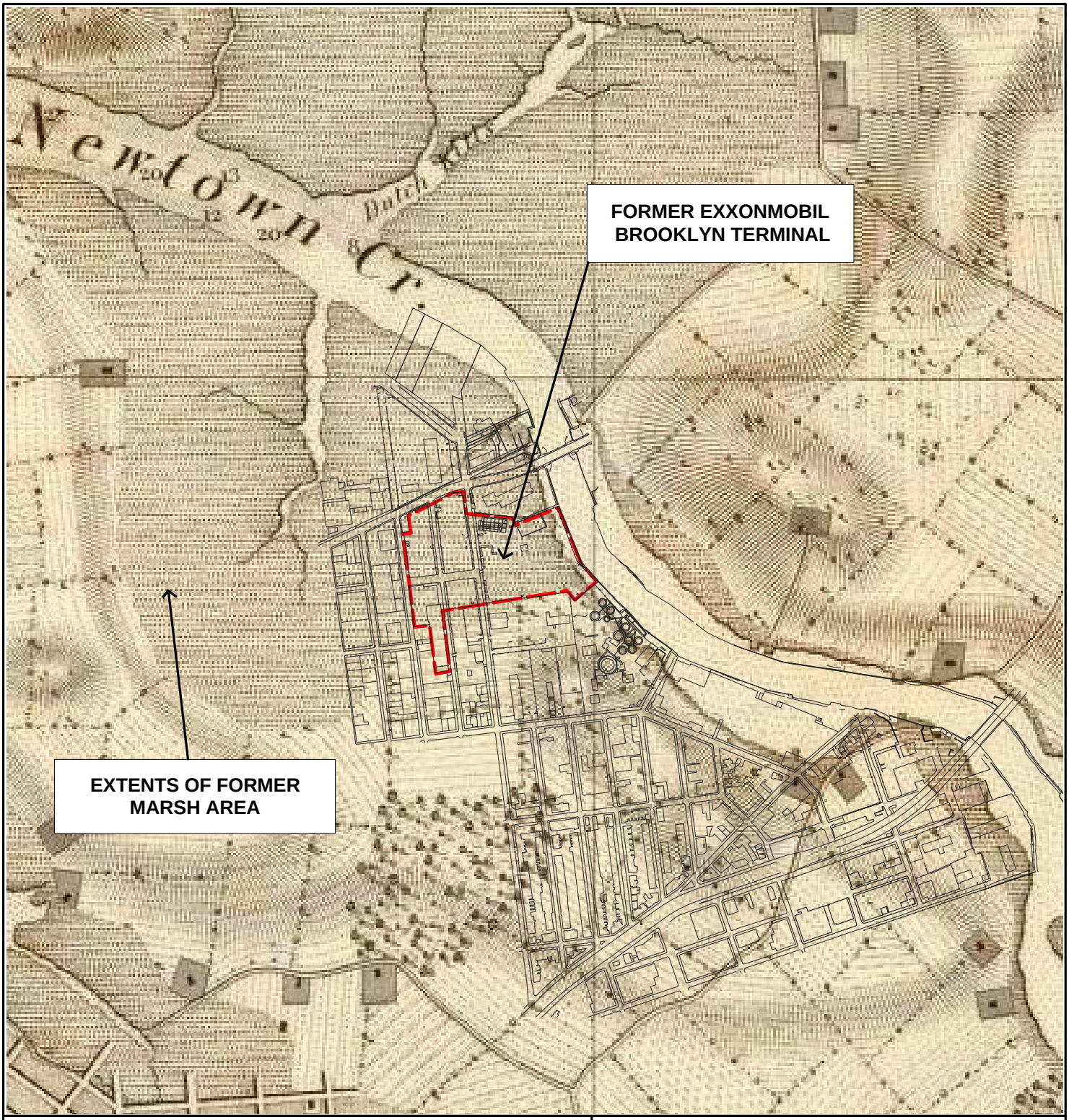

EXPLANATION

FORMER EXXONMOBIL
BROOKLYN TERMINAL

N

SOURCE:
U.S. COAST SURVEY, 1844

Title:

HISTORIC MAP OF GREENPOINT
BROOKLYN, NEW YORK
CIRCA 1844

EXXONMOBIL
GEENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: B.P.	Date: 15MAY2012	FIGURE
Prepared by: B.P.	Scale: 1" = 1000'	6
Project Mgr: C.P.	Project: 0172.0030Y030	
File No: 0172.0030E1875.107.wor		

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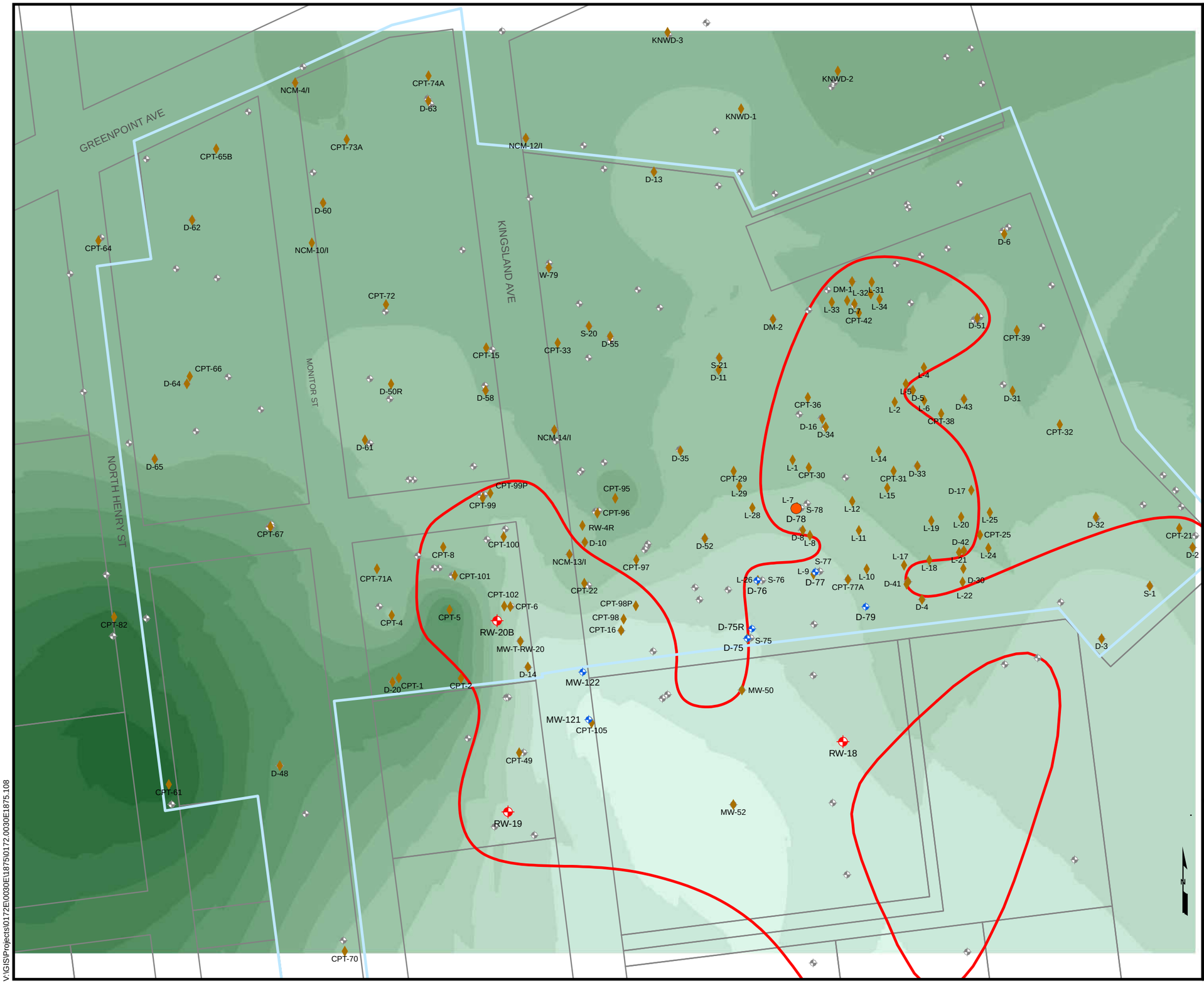

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Legend

- Proposed Recovery Well Location
- Monitoring Wells Used to Evaluate Recovery Well Location
- Contouring Data Point
- Monitoring Well Location
- Recovery Well Location
- FormerBrooklynTerminal_AllParcels
- Free Product Extent (9/13/2011)

Semi-Confining Unit Base Elevation Range

Feet Relative to Mean Sea Level

- -34.99 - -32.5
- -32.49 - -30
- -29.99 - -27.5
- -27.49- -25
- -24.99 - -22.5
- -22.49 - -20
- -19.99 - -17.5
- -17.49 - -15
- -14.99 - -12.5
- -12.49 - -10
- -9.99 - -7.5
- -7.49 - -5
- -4.99 - -2.5
- -2.49 - 0

NOTES:

1. Boring locations that did not provide information on the base of the semi-confining unit were not used in contouring.

2. At boring locations CPT-1, CPT-2, CPT-5, CPT-61, CPT-82, D-20 and D-48, a thick confining unit extended beyond the termination depth of the boring. At these locations, the termination depth of the boring (i.e., values between 36 and 50 ft below land surface) was used to contour the base of the semi-confining unit.

120 0 Feet

Title:

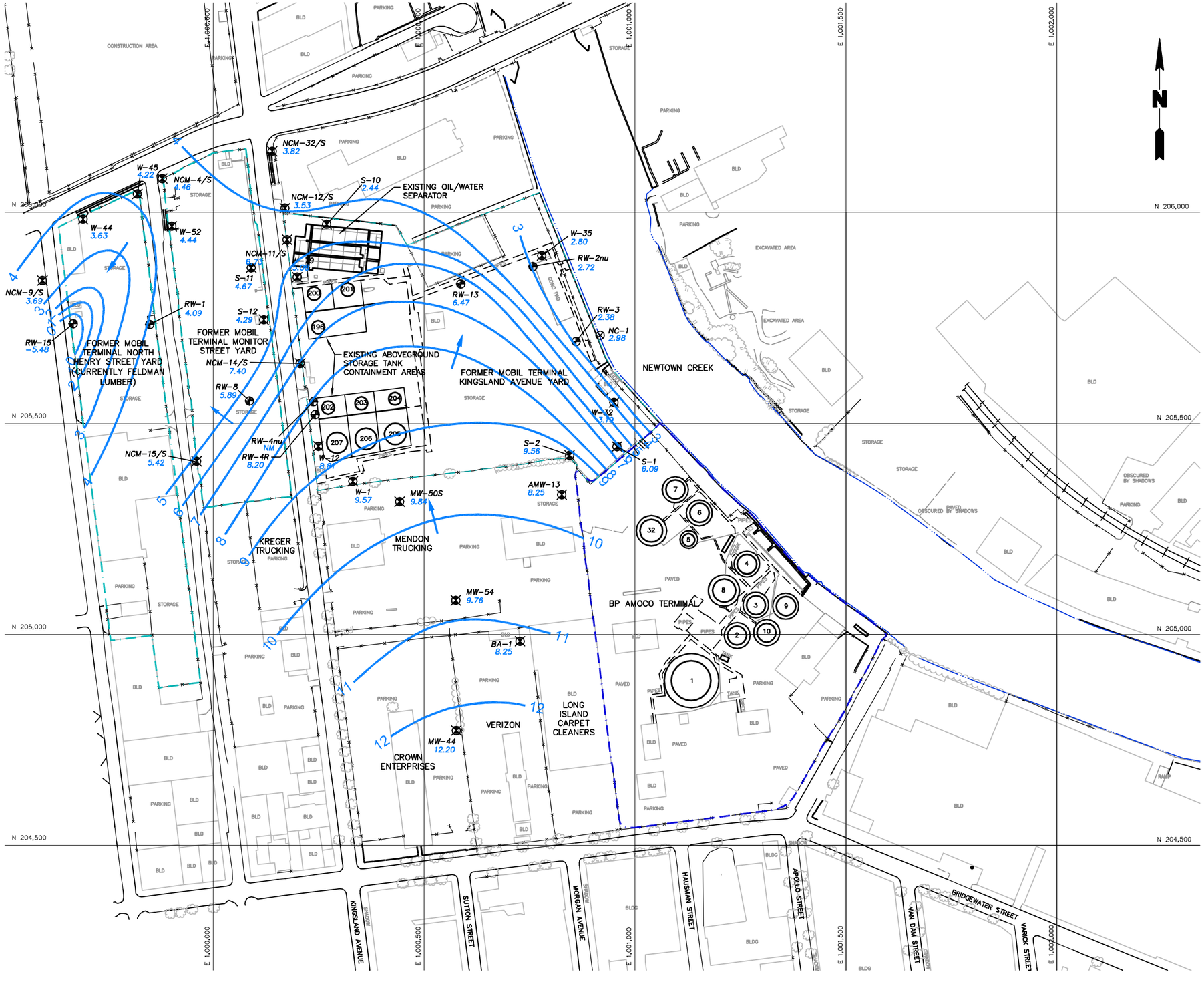
CONFINING UNIT BASE ELEVATION MAP

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For: EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: B.P.	Date: 14MAY2012	FIGURE
Prepared by: B.P.	Scale: 1 in = 120 ft	7
Project Mgr: C.P.	Project: 0172.0030Y030	
File No: 0172.0030E1875.108.MXD		



LEGEND

- EXXONMOBIL PROPERTY LINE (APPROX)
- BP AMOCO PROPERTY LINE (APPROX)
- EXISTING OVERHEAD PIPING
- EXISTING FENCELINE
- EXISITNG RAILROAD TRACKS
- EDGE OF WATER (APPROXIMATE)
- (196) EXISTING ABOVEGROUND STORAGE TANK WITH DESIGNATION
- (BLD) EXISTING BUILDING / STRUCTURE DESIGNATION
- W-32 / 3.19 — LOCATION AND DESIGNATION OF EXISTING SHALLOW AQUIFER MONITORING WELL; GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- RW-15 / -5.48 — LOCATION AND DESIGNATION OF EXISTING SHALLOW AQUIFER RECOVERY WELL; GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- NCM-4/S / 4.46 — LOCATION AND DESIGNATION OF EXISTING NYCDEP MONITORING WELL WITH CONSTRUCTION DESIGNATION (APPROXIMATE LOCATION) (S=SHALLOW AQUIFER); GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- NM — NOT MEASURED
- * — NOT USED IN CONTOURING
- 3 — LINE OF EQUAL GROUND WATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- INFERRED DIRECTION OF GROUNDWATER FLOW

NOTES

1. BASE MAP PREPARED FROM AERIAL SURVEY PERFORMED BY ANGLE OF ATTACK LAND SURVEYING, LLC, MAY 2001. ALL TOPOGRAPHIC AND PLANIMETRIC DETAILS WERE PREPARED USING PHOTOGRAMMETRIC METHODS.
2. HORIZONTAL LOCATIONS ARE BASED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
3. ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
4. MONITORING WELLS DESIGNATED WITH AN NM FOR GROUNDWATER ELEVATION OR FREE-PRODUCT THICKNESS WERE UNABLE TO MEASURED DUE TO INACCESSIBILITY OF THE WELL (I.E., CARS/TRUCKS PARKED ON TOP OF WELL, WELL COVERED WITH DEBRIS AND/OR WELL COULD NOT BE LOCATED)
5. FORMER BROOKLYN TERMINAL RECOVERY WELL RW-15 WAS OPERATING AT 15 GPM AT THE TIME OF MEASUREMENT. RECOVERY WELLS RW-1, RW-2nu, RW-3, RW-4R, AND RW-4nu WERE NOT OPERATING AT THE TIME OF MEASUREMENT.
6. GROUNDWATER ELEVATIONS IN MONITORING WELLS BA-1, MW-54, AMW-13, S-10 AND NCM-11/S WERE IGNORED FOR CONTOURING PURPOSES.

NYSPCS, L.I. ZONE, NAD 83 COORDINATES

N 204,500 —— NORTHING (Y-COORDINATE)

E 1,002,000 —— EASTING (X-COORDINATE)

240' 0 240'

Title:

SHALLOW AQUIFER GROUNDWATER ELEVATIONS NOVEMBER 19, 2004

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:
EXXONMOBIL OIL COPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting and Management

Compiled by: T.P.	Date: 15MAY12	FIGURE
Prepared by: J.A.D.	Scale: AS SHOWN	8
Project Mgr: J.P.K.	Project: 0172.0030Y030	
File: 0172.0030E1875.01.DWG		

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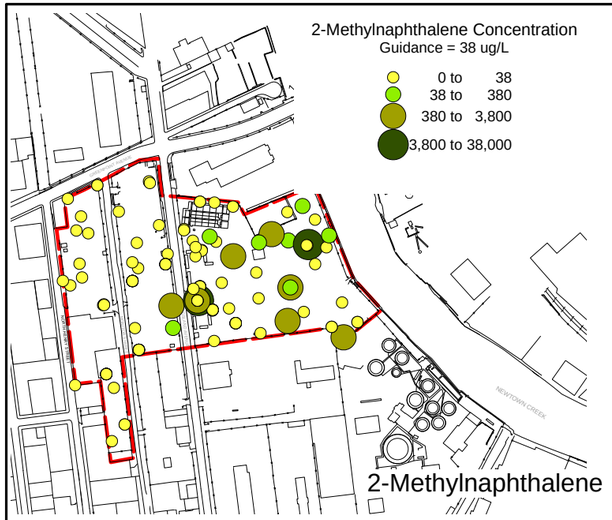

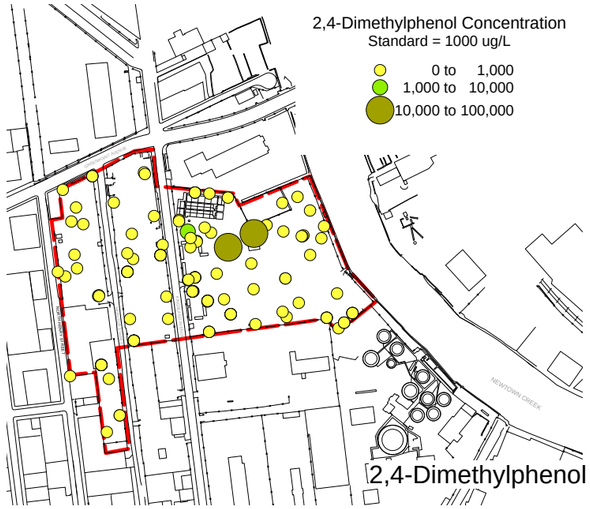

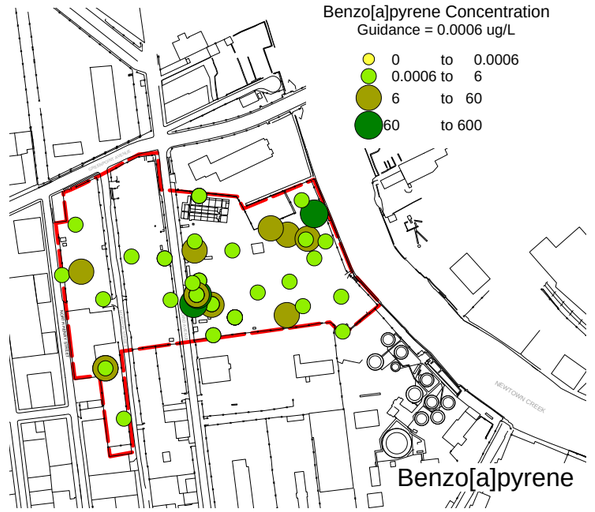

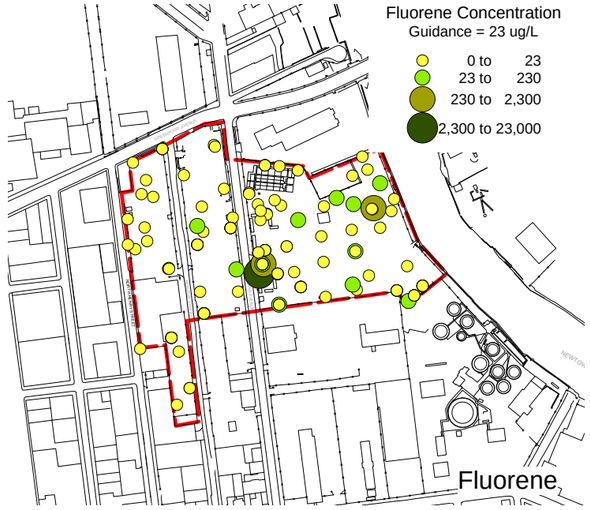

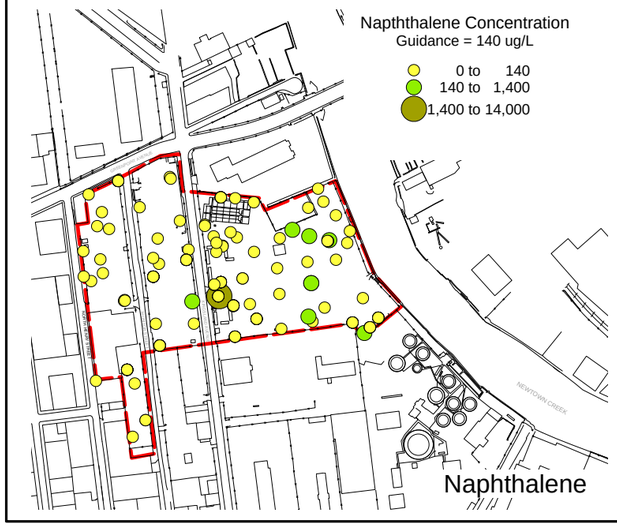

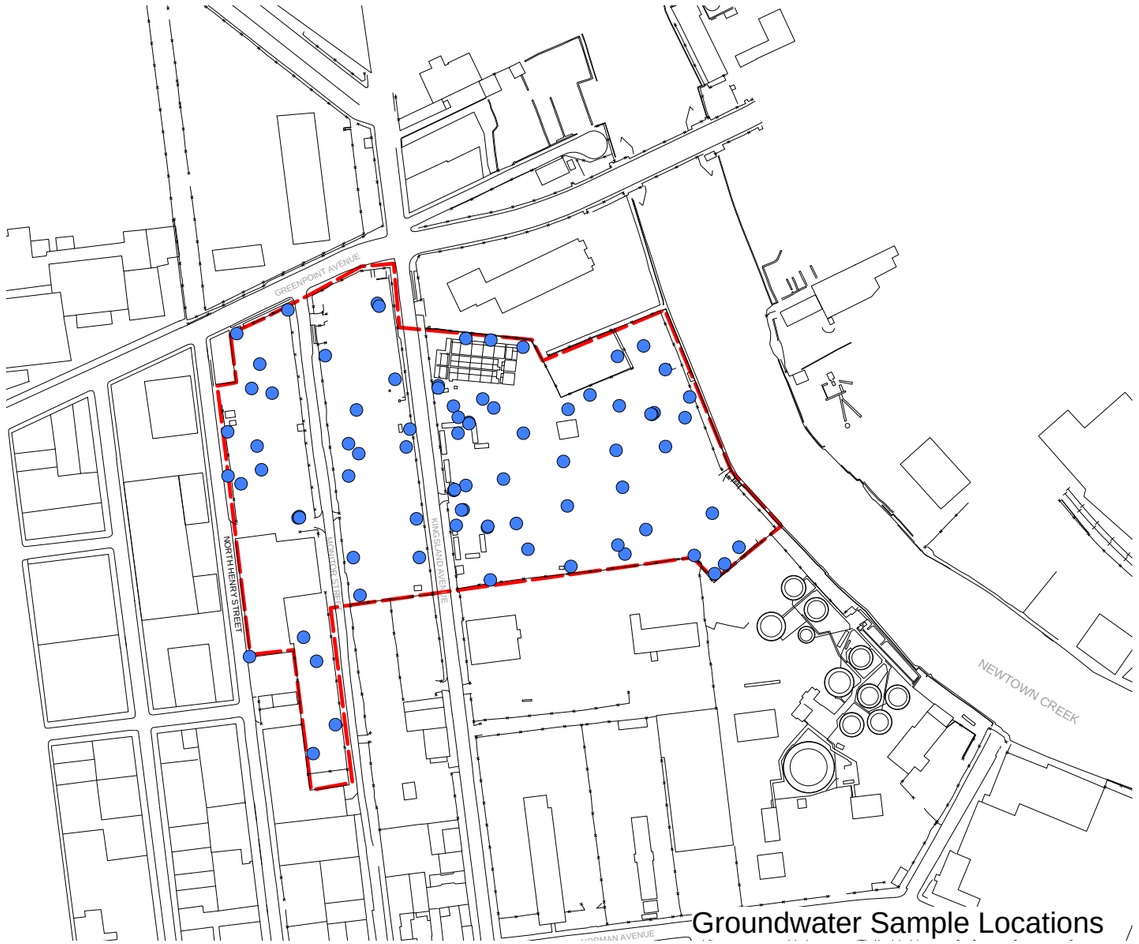

LEGEND

- SAMPLE LOCATIONS
- INDICATES LOCATION WITH SVOC CONCENTRATION BELOW AWQSGVS.
- FORMER EXXONMOBIL BROOKLYN TERMINAL

NOTES

1. CONCENTRATIONS OF EACH COMPOUND ARE COMPARED TO NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES FOR CLASS SD SURFACE WATER CONSISTENT WITH THE WATER QUALITY CLASSIFICATION OF NEWTOWN CREEK.

2. SVOCs SHOWN WERE SELECTED BASED UPON AT LEAST ONE DETECTED EXCEEDANCE OF THEIR RESPECTIVE AWQSGVS. COMPOUNDS THAT DID NOT EXCEED THESE STANDARDS ARE NO SHOWN.

N

Title:

SVOCs ABOVE NYSDEC AWQSGVS FOR CLASS SD WATER

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
BROOKLYN, NEW YORK

Prepared For:
EXXONMOBIL OIL CORPORATION,
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: BP	Date: 15MAY2012	FIGURE 9
Prepared by: BP	Scale: NOT TO SCALE	
Project Mgr: CP	Project: 0172.0030Y030	
File No: 0172.0030E1875.109.WOR		

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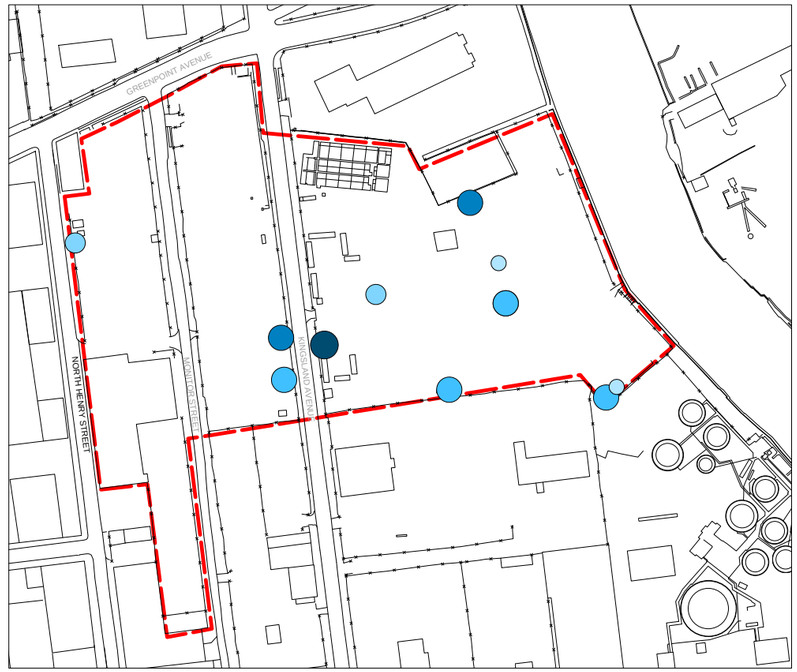
TPH

TPH (ug/L)

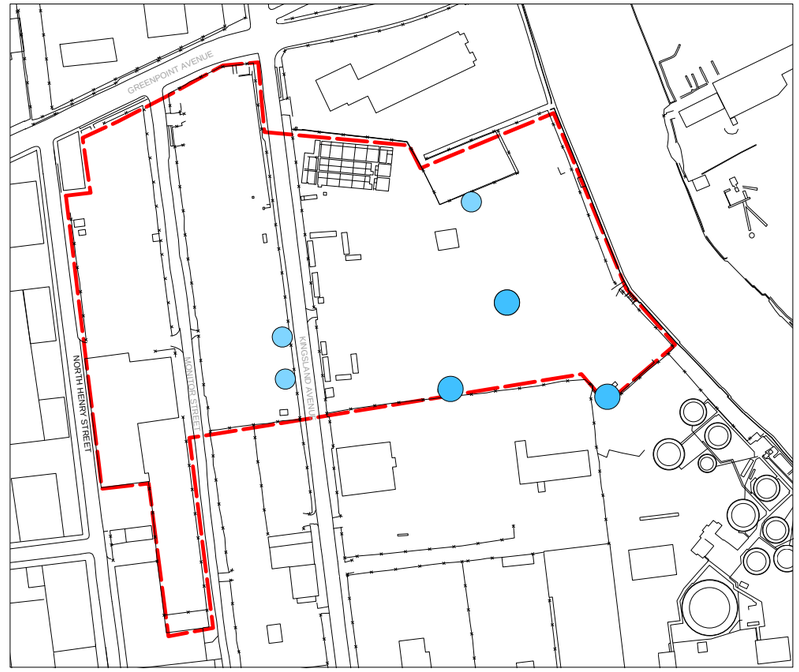
0 to	100
100 to	1,000
1,000 to	10,000
10,000 to	100,000
100,000 to	1,000,000
1,000,000 to	10,000,000



TPH-DRO

TPH DRO (ug/L)

0 to	100
100 to	1,000
1,000 to	10,000
10,000 to	100,000
100,000 to	1,000,000
1,000,000 to	10,000,000



TPH-GRO

TPH GRO (ug/L)

0 to	100
100 to	1,000
1,000 to	10,000
10,000 to	100,000
100,000 to	1,000,000

EXPLANATION

TPH-DRO TOTAL PETROLEUM HYDROCARBONS - DIESEL-RANGE ORGANICS

TPH-GRO TOTAL PETROLEUM HYDROCARBONS - GASOLINE-RANGE ORGANICS

FORMER EXXONMOBIL BROOKLYN TERMINAL

NOTE

TOTAL PETROLEUM HYDROCARBON (TPH) WERE ANALYZED VIA METHOD EPA 418.1. THP-GRO AND TPH-DRO WERE ANALYZED VIA SW846 8015.

N

Title:

TOTAL PETROLEUM HYDROCARBONS IN GROUNDWATER

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: B.P.	Date:16MAY2012
Prepared by: B.P.	Scale: NOT TO SCALE
Project Mgr: C.P.	Project: 0172.0030Y030
File No: 0172.0030E1875.110.WOR	

FIGURE **10**

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GREENPOINT AVENUE

NORTH HENRY STREET

MONITOR STREET

KINGSLAND AVENUE

MTBE Concentration (ug/L)
Guidance = 10 ug/L

- < 10
- 10 to 100
- 100 to 1,000
- 1,000 to 10,000
- 10,000 to 100,000

LEGEND

- INDICATES LOCATIONS WITH MTBE CONCENTRATIONS BELOW AWQSGVS.
- INDICATES SAMPLE LOCATIONS WHERE THE LABORATORY REPORTINGLIMIT EXCEEDED THE REGULATORY STANDARD FOR MTBE (I.E., COMPARISON TO STANDARD IS INCONCLUSIVE).
- FORMER EXXONMOBIL BROOKLYN TERMINAL

MTBE METHYL TERTIARY-BUTYL ETHER

UG/L MICROGRAMS PER LITER

NOTES:

1. MTBE CONCENTRATIONS ARE COMPARED TO NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES (AWQSGVs) FOR CLASS GA GROUNDWATER.

N

Title:

MTBE IN GROUNDWATER

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: B.P.	Date:16MAY2012	FIGURE
Prepared by: B.P.	Scale: 1" = 150'	11
Project Mgr: C.P.	Project: 0172.0030Y030	
File No: 0172.0030E1875.111.WOR		

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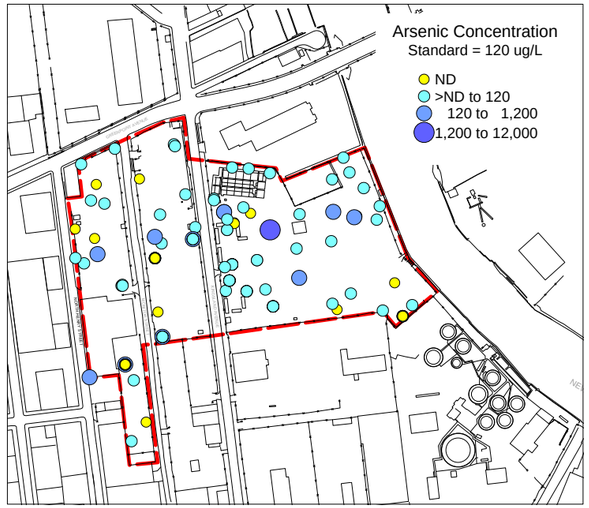
ARSENIC



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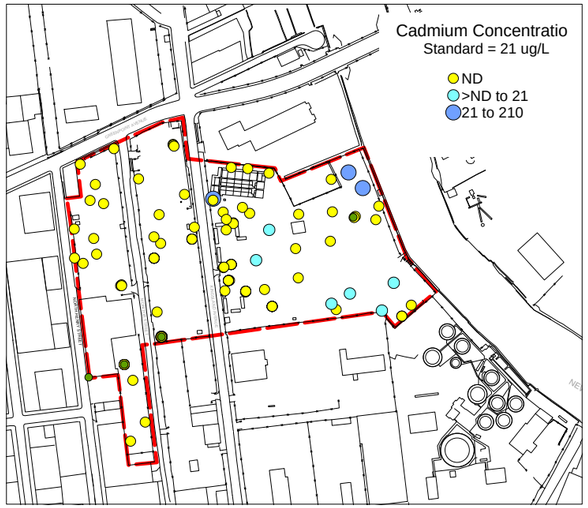
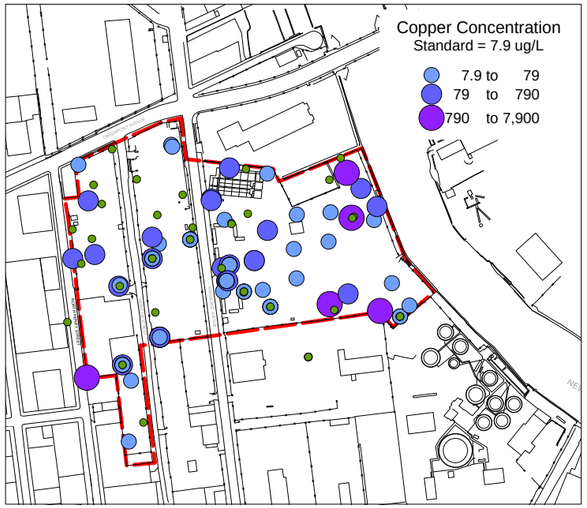
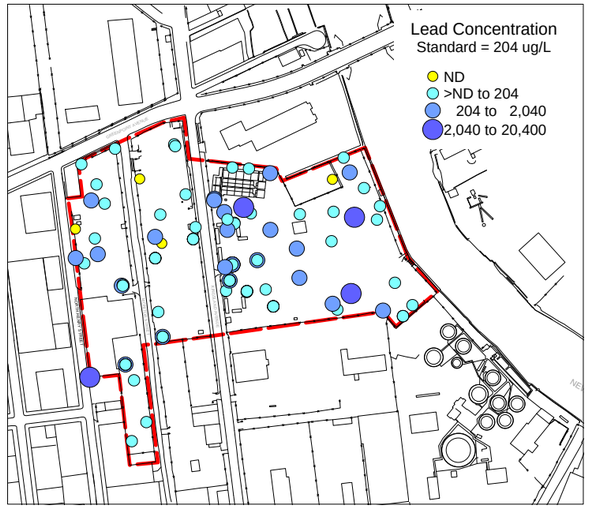


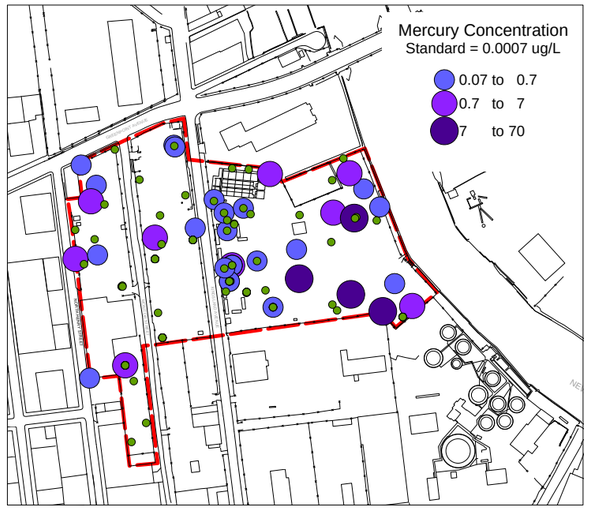
COPPER



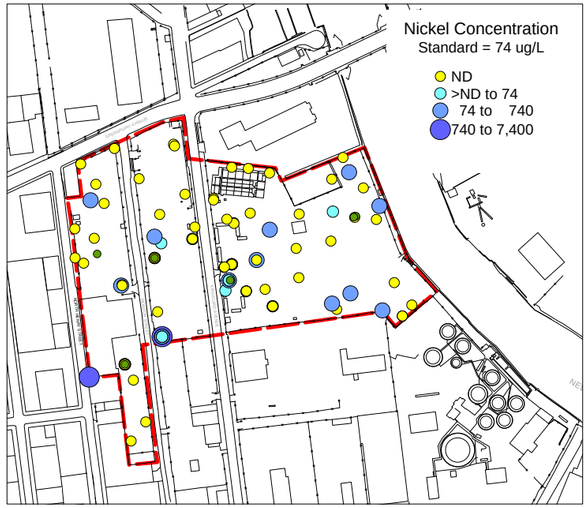
LEAD



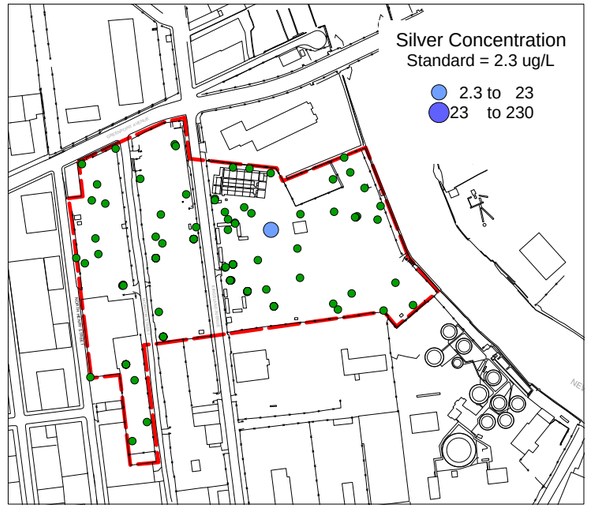
MERCURY



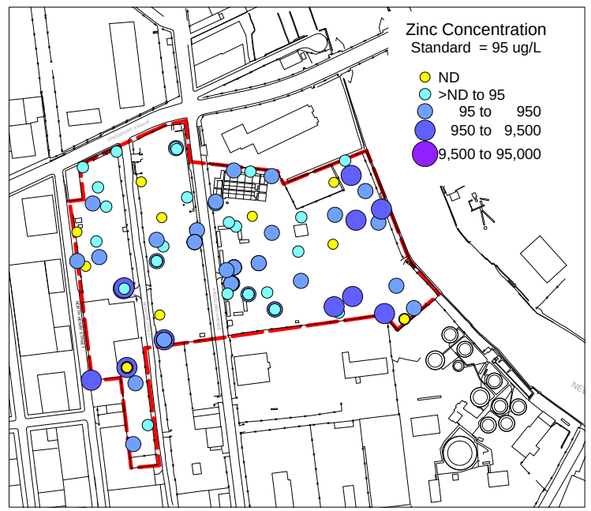
NICKEL



SILVER



ZINC



LEGEND

- INDICATES SAMPLE LOCATIONS WHERE THE LABORATORY REPORTING LIMIT EXCEEDED THE REGULATORY STANDARD FOR A PARTICULAR COMPOUND (I.E., COMPARISON TO STANDARDS IS INCONCLUSIVE).
- INDICATES LOCATION WITH METAL CONCENTRATION BELOW AWQSGVS.
- FORMER EXXONMOBIL BROOKLYN TERMINAL
- UG/L MICROGRAMS PER LITER

NOTES

1. GROUNDWATER BENEATH THE PROJECT AREA IS IMPACTED BY SALTWATER INTRUSION DUE TO HISTORICAL GROUNDWATER PUMPING. ALKALI METALS RELATED TO SALTWATER INTRUSION ARE NOT SHOWN.

2. CONCENTRATIONS OF EACH COMPOUND ARE COMPARED TO NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES FOR CLASS SD SURFACE WATER CONSISTENT WITH THE WATER QUALITY CLASSIFICATION OF NEWTOWN CREEK.

3. METALS SHOWN WERE SELECTED BASED UPON AT LEAST ONE DETECTED EXCEEDANCE OF THEIR RESPECTIVE AWQSGVS.

N

Title:

METALS ABOVE NYSDEC AWQSGVS FOR CLASS SD WATER

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:
EXXONMOBIL OIL CORPORATION,
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: BP	Date:16MAY2012	FIGURE
Prepared by: BP	Scale: NOT TO SCALE	
Project Mgr: CP	Project: 0172.0030Y030	12
File No: 0172.0030E1875.112.WOR		

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NORTH HENRY ST

MONITOR ST

KINGSLAND AVE

NEWTOWN CREEK

LEGEND

FORMER EXXONMOBIL BROOKLYN TERMINAL

REMEDIATION SYSTEM GROUNDWATER PIPING

RECOVERY AND CONTAINMENT SYSTEM (RCS)

TOTAL DISSOLVED SOLIDS (TDS) CONCENTRATIONS (IN MILLIGRAMS/LITER)

- < 500
- 500 TO 2,000
- >2,000 TO 200,000

N

Title:

TOTAL DISSOLVED SOLID CONCENTRATIONS IN GROUNDWATER

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: B.P.	Date: 16MAY2012	FIGURE
Prepared by: B.P.	Scale: 1" = 150'	13
Project Mgr: C.P.	Project: 0172.0030Y030	
File No: 0172.0030E1875.113.WOR		

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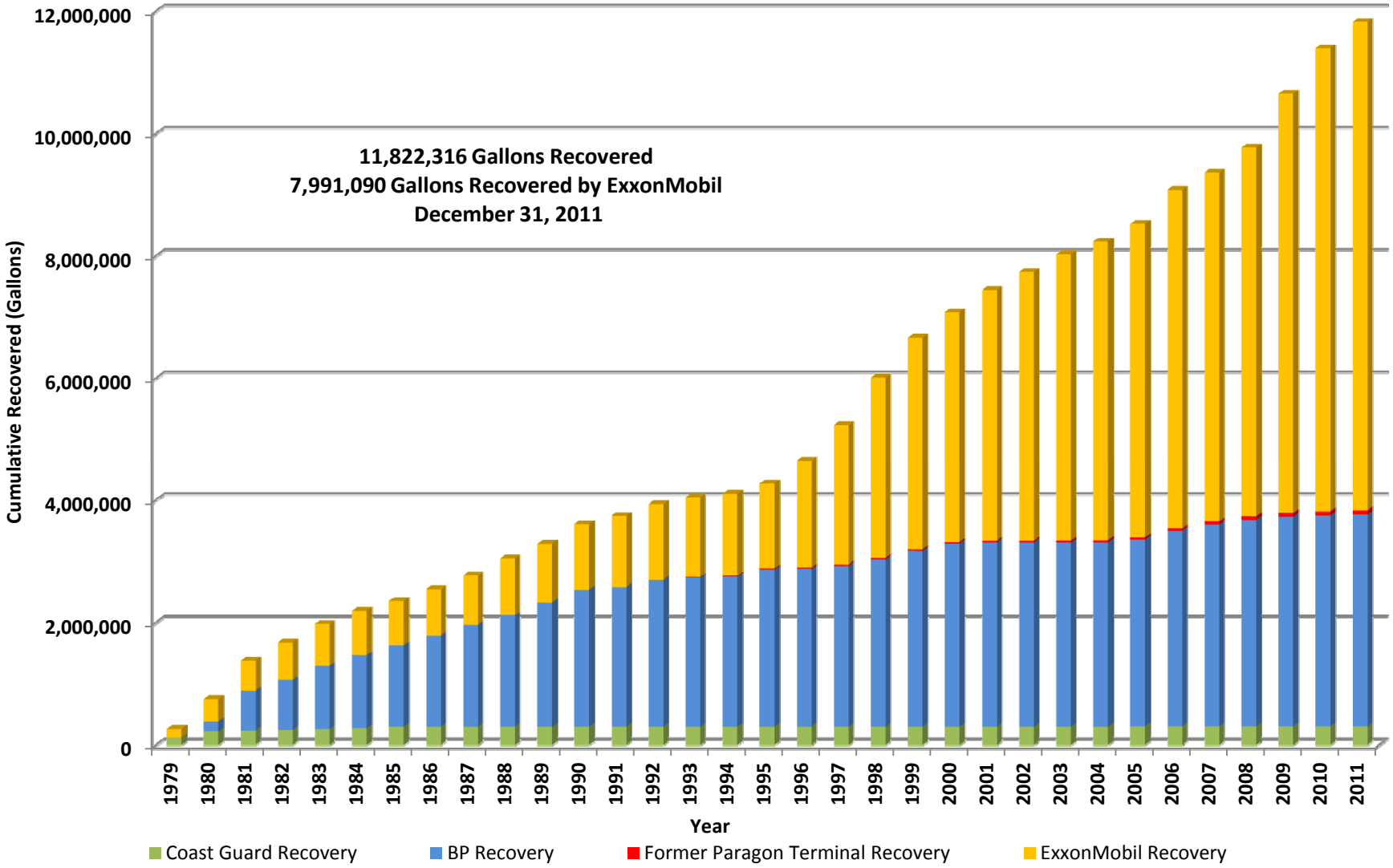
Greenpoint Area Cumulative Free-Product Recovered
1979 to Present



GREENPOINT AVE

NEWTOWN CREEK

NORTH HENRY ST

CALYER ST

MONITOR ST

KINGSLAND AVE

Legend

- Existing ExxonMobil Recovery Well
- Existing ExxonMobil Monitoring Well
- Soil Boring
- Cone Penetrometer Test (CPT) Boring
- NYCDEP Monitoring Well
- Historic Recovery Well
- Historic Monitoring Well
- Former ExxonMobil Brooklyn Terminal

NOTE

HISTORIC MONITORING WELLS AND RECOVERY WELLS ARE THOSE THAT WERE INSTALLED BY EXXONMOBIL OR THIRD PARTIES DURING PREVIOUS SITE ACTIVITIES AND THAT ARE NO LONGER IN EXISTANCE.

N

0 75 Feet

Title:

SITE-WIDE BORINGS AND MONITORING WELLS

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX

ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: B.P.	Date: 14MAY2012	PLATE 1
Prepared by: B.P.	Scale: 1 in = 75 ft	
Project Mgr: C.P.	Project: 0172.0030Y030	
File No: 0172.0030E1875.115.mxd		

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Legend

- MONITORING WELL LOCATION AND DESIGNATION
- RECOVERY WELL LOCATION AND DESIGNATION
- SOIL BORING LOCATION AND DESIGNATION
- CPT BORING LOCATION AND DESIGNATION
- FORMER EXXONMOBIL BROOKLYN TERMINAL
- LINE OF CROSS SECTION

N

0 75 150 Feet

Title:

GENERALIZED HYDROGEOLOGIC CROSS SECTION TRANSECTS

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: B.P.	Date: 15MAY2012	PLATE
Prepared by: B.P.	Scale: 1 in = 75 ft	2
Project Mgr: C.P.	Project: 0172.0030Y030	
File No: 0172.0030E1875.116.MXD		

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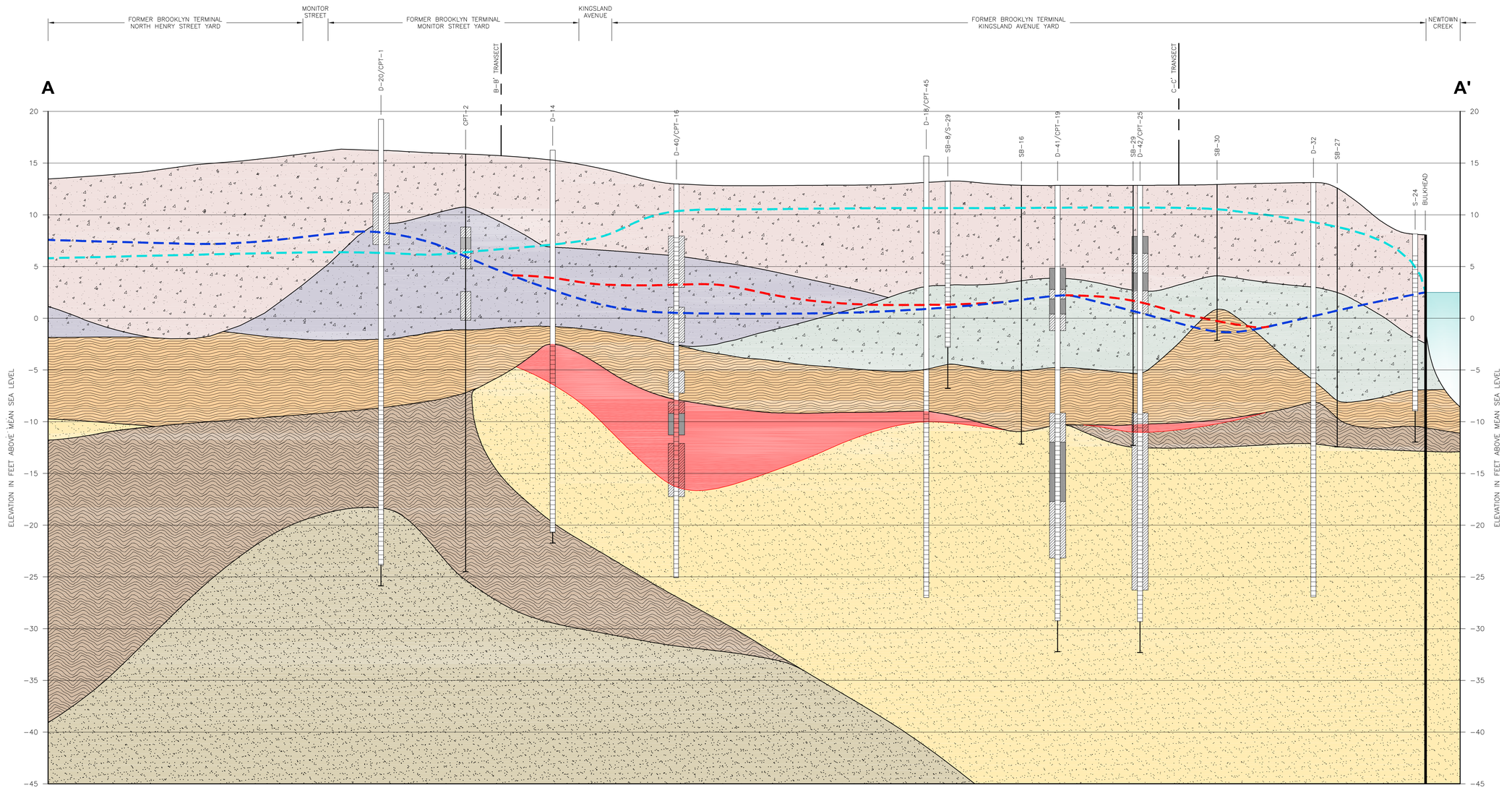
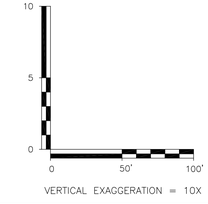


LEGEND

- FILL MATERIAL CONSISTING OF VARYING AMOUNTS OF SAND, GRAVEL, COBBLE, BRICK, CINDER, WOOD AND CONCRETE
- FILL MATERIAL CONSISTING PRIMARILY OF SILT WITH VARYING AMOUNTS OF SAND AND CLAY
- FILL MATERIAL CONSISTING PRIMARILY OF SAND WITH VARYING AMOUNTS OF SILT AND/OR GRAVEL
- PRIMARILY SAND WITH VARYING AMOUNTS OF SILT AND/OR GRAVEL
- CLAY, PEAT AND SILT WITH INTERBEDDED SAND LAYERS AT SOME LOCATIONS
- PRIMARILY SILT WITH VARYING AMOUNTS OF SAND AND CLAY
- VARYING AMOUNTS OF COMPACTED SAND, CLAY, SILT AND COBBLES
- SUBSURFACE ZONE WITH CPT UVIF RESULTS OF LESS THAN 10 VOLTS
- SUBSURFACE ZONE WITH CPT UVIF RESULTS OF EQUAL TO OR GREATER THAN 10 VOLTS
- ESTIMATED FREE-PRODUCT THICKNESS
- FREE PRODUCT POTENTIOMETRIC HEAD ELEVATION AS MEASURED IN REGIONAL AQUIFER MONITORING WELLS
- GROUNDWATER POTENTIOMETRIC HEAD ELEVATION AS MEASURED IN REGIONAL AQUIFER MONITORING WELLS (CORRECTED FOR THE PRESENCE OF FREE PRODUCT, WHERE APPLICABLE)
- GROUNDWATER POTENTIOMETRIC HEAD ELEVATION AS MEASURED IN SHALLOW AQUIFER MONITORING WELLS
- UNKNOWN BOUNDARY

NOTES

1. CPT ULTRAVIOLET-INDUCED FLUORESCENCE (UVIF) RETURNS ARE PLOTTED ON A SCALE OF 0 TO 10 VOLTS. CPT UVIF RETURNS PROVIDE A RELATIVE MEASURE OF SPECIFIC COMPONENTS AND DEGREE OF SATURATION OF FREE-PRODUCT PRESENT IN THE BOREHOLE BUT ARE NOT INDICATIVE OF FREE-PRODUCT MOBILITY.
2. THE UPPERMOST SECTION OF EACH CPT BORING WAS CLEARED FOR UTLIITIES PRIOR TO ADVANCING OF THE UVIF MODULE. THEREFORE, UVIF DATA FOR THE DISTURBED INTERNAL IS NOT REPRESENTATIVE OF ACTUAL CONDITIONS AND WAS NOT INCLUDED ON THIS FIGURE.
3. GROUNDWATER ELEVATIONS AND APPARENT FREE-PRODUCT THICKNESS MEASURED ON MARCH 18, 2011.



VERTICAL EXAGGERATION = 10X

Title:

GENERALIZED HYDROGEOLOGIC CROSS SECTION A-A'

EXXONMOBIL GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting and Management

Compiled by: L.D.	Date: 14MAY12	PLATE
Prepared by: G.M.	Scale: AS SHOWN	3
Project Mgr: C.P.	Project: 0172.0030E030	
File: 0172.0030Y1875.02		

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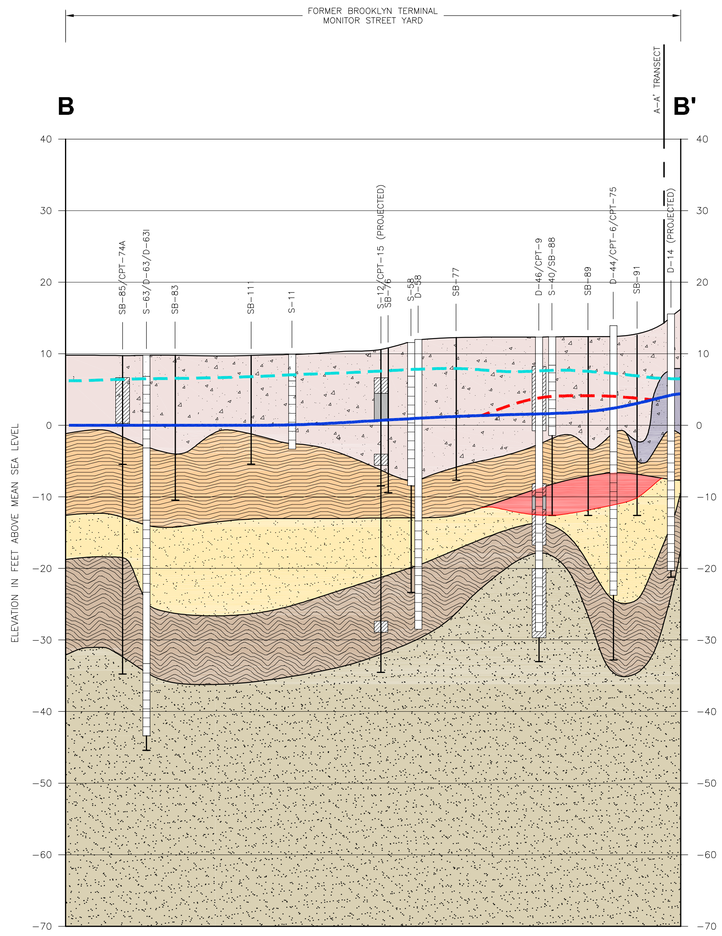
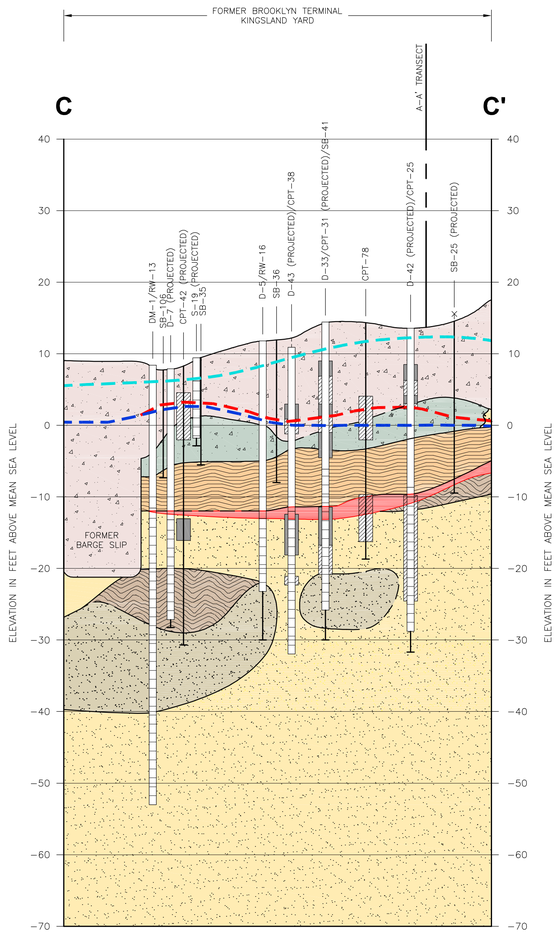


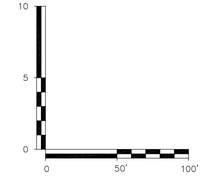


LEGEND

- FILL MATERIAL CONSISTING OF VARYING AMOUNTS OF SAND, GRAVEL, COBBLE, BRICK, CINDER, WOOD AND CONCRETE
- FILL MATERIAL CONSISTING PRIMARILY OF SILT WITH VARYING AMOUNTS OF SAND AND CLAY
- FILL MATERIAL CONSISTING PRIMARILY OF SAND WITH VARYING AMOUNTS OF SILT AND/OR GRAVEL
- PRIMARILY SAND WITH VARYING AMOUNTS OF SILT AND/OR GRAVEL
- CLAY, PEAT AND SILT WITH INTERBEDDED SAND LAYERS AT SOME LOCATIONS
- PRIMARILY SILT WITH VARYING AMOUNTS OF SAND AND CLAY
- VARYING AMOUNTS OF COMPACTED SAND, CLAY, SILT AND COBBLES
- SUBSURFACE ZONE WITH CPT UVIF RESULTS OF LESS THAN 10 VOLTS
- SUBSURFACE ZONE WITH CPT UVIF RESULTS OF EQUAL TO OR GREATER THAN 10 VOLTS
- ESTIMATED FREE–PRODUCT THICKNESS
- FREE PRODUCT POTENTIOMETRIC HEAD ELEVATION AS MEASURED IN REGIONAL AQUIFER MONITORING WELLS
- GROUNDWATER POTENTIOMETRIC HEAD ELEVATION AS MEASURED IN REGIONAL AQUIFER MONITORING WELLS (CORRECTED FOR THE PRESENCE OF FREE PRODUCT, WHERE APPLICABLE)
- GROUNDWATER POTENTIOMETRIC HEAD ELEVATION AS MEASURED IN SHALLOW AQUIFER MONITORING WELLS
- UNKNOWN BOUNDARY

NOTES

1. CPT ULTRAVIOLET–INDUCED FLUORESCENCE (UVIF) RETURNS ARE PLOTTED ON A SCALE OF 0 TO 10 VOLTS. CPT UVIF RETURNS PROVIDE A RELATIVE MEASURE OF SPECIFIC COMPONENTS AND DEGREE OF SATURATION OF FREE–PRODUCT PRESENT IN THE BOREHOLE BUT ARE NOT INDICATIVE OF FREE–PRODUCT MOBILITY.
2. THE UPPERMOST SECTION OF EACH CPT BORING WAS CLEARED FOR UTILITIES PRIOR TO ADVANCING OF THE UVIF MODULE. THEREFORE, UVIF DATA FOR THE DISTURBED INTERNAL IS NOT REPRESENTATIVE OF ACTUAL CONDITIONS AND WAS NOT INCLUDED ON THIS FIGURE.
3. GROUNDWATER ELEVATIONS AND APPARENT FREE–PRODUCT THICKNESS MEASURED ON MARCH 18, 2011.



VERTICAL EXAGGERATION = 10X

Title:

GENERALIZED HYDROGEOLOGIC CROSS SECTIONS B-B' AND C-C'

EXXONMOBIL GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting and Management

Compiled by: L.D.	Date: 14MAY12	PLATE
Prepared by: G.M.	Scale: AS SHOWN	4
Project Mgr: C.P.	Project: 0172.0030E030	
File: 0172.0030Y1875.02		

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N 204,500

GREENPOINT AVENUE
CALYER STREET
MESEROLE AVENUE
NORMAN AVENUE
NORTH HENRY STREET
RUSSELL STREET
MONITOR STREET
KINGSLAND AVENUE
NEWTOWN CREEK
BRIDGEWATER STREET
HAUSMAN STREET
APOLLO STREET
VAN DAM STREET
VARICK ST

FORMER BROOKLYN TERMINAL
NORTH HENRY YARD

FORMER BROOKLYN TERMINAL
MONITOR STREET YARD

FORMER BROOKLYN TERMINAL
KINGSLAND AVENUE YARD

S-63 NM
NCM-4/S 7.30
W-45 6.89
W-44 6.09
W-52 7.07
S-10 5.03
S-28 5.78
NCM-11/S 7.79
S-11 6.86
S-44 6.41
S-46 6.71
S-39 6.85
W-79 6.04
RW-15 6.15
S-45 6.45
RW-1 NM
S-12 5.56
S-20 7.02
S-55 7.41
S-47 NM
S-70 7.09*
S-58 7.54
S-48 6.35
S-73 6.44
S-72 6.42
RW-8 NM
S-68 NM
S-40 8.42
NCM-14/S 8.82
S-27 8.46
S-66 8.48
S-74 7.41
S-41 8.25
NCM-15/S NM
S-57 10.27
S-54 NM
W-12 11.11
S-56R NM
W-1 14.83
S-18 9.78
S-21 8.10
S-22 8.51
S-23 8.77
S-17 8.80
S-16 10.49
S-29 10.58
S-2 12.42
S-69 NM
S-15 NM
S-67 NM
W-35 NM
RW-13 NM
S-19 8.99
S-30 6.70
S-51 7.73
S-14 8.89
S-13 9.81
S-24 8.58
W-32 8.24
S-26 8.40
S-1 9.53
S-49 NM
S-50 NM

LEGEND

- FORMER EXXONMOBIL BROOKLYN TERMINAL
- S-35 6.85 — LOCATION AND DESIGNATION OF EXISTING SHALLOW AQUIFER MONITORING WELL; GROUNDWATER ELEVATION
- RW-15 — LOCATION AND DESIGNATION OF EXISTING SHALLOW RECOVERY WELL
- NCM-4/S 7.30 — LOCATION AND DESIGNATION OF EXISTING NYCDEP MONITORING well with CONSTRUCTION DESIGNATION (APPROXIMATE LOCATION) (S=SHALLOW AQUIFER) GROUNDWATER ELEVATION
- NM — NOT MEASURED

NOTES

1. BASE MAP PREPARED FROM AERIAL SURVEY PERFORMED BY ANGLE OF ATTACK LAND SURVEYING, LLC, MAY 2001. ALL TOPOGRAPHIC AND PLANIMETRIC DETAILS WERE PREPARED USING PHOTOGRAMMETRIC METHODS.
2. HORIZONTAL LOCATIONS ARE BASED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
3. ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
4. MONITORING WELLS DESIGNATED WITH AN NM FOR GROUNDWATER ELEVATION COULD NIT BE MEASURED DUE TO INACCESSIBILITY OF THE WELL (I.E., CARS/TRUCKS PARKED ON TOP OF WELL, WELL COVERED WITH DEBRIS AND/OR WELL COULD NOT BE LOCATED).
5. RECOVERY WELLS RW-1, RW-13, RW-15 AND RW-20 WERE NOT OPERATING AT THE TIME OF MEASUREMENT.

NYSPCS, L.I. ZONE, NAD 83 COORDINATES

N 204,500 — NORTHING (Y-COORDINATE)
E 1,002,000 — EASTING (X-COORDINATE)

100' 0 100'

Title:
SHALLOW AQUIFER GROUNDWATER ELEVATIONS MARCH 18, 2011

GREENPOINT, BROOKLYN, NEW YORK
EXXONMOBIL GREENPOINT PETROLEUM REMEDIATION PROJECT

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting and Management

Compiled by: M.R.	Date: 15MAY12	PLATE
Prepared by: G.M.	Scale: AS SHOWN	5
Project Mgr: J.P.K.	Project: 0172.0030E030	
File: 0172.0030E1875.04.DWG		

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N 206,000
N 205,500
N 205,000
N 204,500

GREENPOINT AVENUE
CALYER STREET
MESEROLE AVENUE
NORMAN AVENUE
RUSSELL STREET
NORTH HENRY STREET
MONITOR STREET
KINGSLAND AVENUE
NEWTOWN CREEK

FORMER BROOKLYN TERMINAL
NORTH HENRY YARD

FORMER BROOKLYN TERMINAL
MONITOR STREET YARD

FORMER BROOKLYN TERMINAL
KINGSLAND AVENUE YARD

NCM-4/I 3.12
D-63 0.18
D-63 2.02
D-62 −0.14
D-60 0.16
D-13 0.85
D-67 NM
DM-6 NM
D-6 NM
DM-7 NM
D-21 0.92
DM-1 NM
RW-13 NM
D-7 2.82
D-53 0.63
D-55 1.19
D-55I 0.77
D-51 1.74
D-51I 1.20
D-64 0.96
D-58 0.66
D-50R NM
D-61 1.17
D-65 NM
NCM-14/I 1.18
NCM-14/D 1.37
D-16 0.19
D-34 −0.04
RW-16 0.90
D-5 1.67
D-43 2.88
D-33 −0.06
D-35 2.94
D-66 NM
D-73 1.12
D-77 NM
D-72 1.27
D-68 NM
D-68I NM
D-46 1.92
D-57 8.87
D-54R NM
D-54I 10.59
D-56R 10.00
D-52 0.31
D-8 3.49
D-32 0.39
D-42 0.74
D-70 NM
D-74 1.70
D-45 2.56
D-10 2.59
NCM-13/I 2.54
D-41 2.00
D-44 2.06
RW-20A NM
RW-20B NM
D-14 2.72
D-40 0.42
D-18 0.78
D-54 2.74
RW-14 −18.76
D-2 −1.54
D-3 −1.86
D-20 0.11
D-48 NM
MW-9S NM

LEGEND

- FORMER EXXONMOBIL BROOKLYN TERMINAL
- D-18 0.79 — LOCATION AND DESIGNATION OF EXISTING REGIONAL AQUIFER (CONFINED) MONITORING WELL GROUNDWATER ELEVATION, IN FEET ABOVE MEAN SEA LEVEL
- MW-34 −3.19 — LOCATION AND DESIGNATION OF EXISTING/NEW REGIONAL AQUIFER (UNCONFINED) MONITORING WELL GROUNDWATER ELEVATION, IN FEET ABOVE MEAN SEA LEVEL
- MW-50D −0.70 — LOCATION AND DESIGNATION OF EXISTING/NEW REGIONAL AQUIFER MONITORING WELL (UNCONFINED) SCREENED DEEP (BELOW CLAY LAYER) GROUNDWATER ELEVATION, IN FEET ABOVE MEAN SEA LEVEL
- MW-54 9.56 — LOCATION AND DESIGNATION OF EXISTING/NEW REGIONAL AQUIFER MONITORING WELL (UNCONFINED) SCREENED SHALLOW (ABOVE CLAY LAYER) GROUNDWATER ELEVATION, IN FEET ABOVE MEAN SEA LEVEL
- RW-14 −18.76 — LOCATION AND DESIGNATION OF EXISTING REGIONAL AQUIFER RECOVERY WELL – ACTIVE RECOVERY WELLS UTILIZING WATER DEPRESSION IDENTIFIED IN PURPLE. RECOVERY WELLS WITH PRODUCT ONLY – RECOVERY EQUIPMENT SHOW IN GREEN GROUNDWATER ELEVATION, IN FEET ABOVE MEAN SEA LEVEL
- NCM-4/I 3.12 — LOCATION AND DESIGNATION OF EXISTING NYCDEP MONITORING WELL WITH CONSTRUCTION DESIGNATION (APPROXIMATE LOCATION) (S=SHALLOW AQUIFER, I=REGIONAL AQUIFER, D=TILL AQUIFER) GROUNDWATER ELEVATION, IN FEET ABOVE MEAN SEA LEVEL
- NM — NOT MEASURED
- 2 — LINE OF EQUAL GROUNDWATER ELEVATION,
- APPROXIMATE DIRECTION OF GROUNDWATER FLOW

NOTES

1. BASE MAP PREPARED FROM AERIAL SURVEY PERFORMED BY ANGLE OF ATTACK LAND SURVEYING, LLC, MAY 2001. ALL TOPOGRAPHIC AND PLANIMETRIC DETAILS WERE PREPARED USING PHOTOGRAMMETRIC METHODS.
2. HORIZONTAL LOCATIONS ARE BASED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
3. ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
4. MONITORING WELLS DESIGNATED WITH AN NM FOR GROUNDWATER ELEVATION WERE UNABLE TO BE MEASURED DUE TO INACCESSIBILITY OF THE WELL (I.E., CARS/TRUCKS PARKED ON TOP OF WELL, WELL COVERED WITH DEBRIS AND/OR WELL COULD NOT BE LOCATED)
5. GROUNDWATER ELEVATIONS HAVE BEEN CORRECTED, WHERE NECESSARY, FOR THE PRESENCE OF FREE-PHASE PETROLEUM PRODUCT (FREE-PRODUCT).
6. GROUNDWATER ELEVATIONS IN MONITORING WELLS INSTALLED IN THE REGIONAL AQUIFER ON THE FORMER MOBIL BROOKLYN TERMINAL PROPERTY ARE INDICATIVE OF CONFINED CONDITIONS.
7. SOME GROUNDWATER ELEVATION CONTOURS IN THE IMMEDIATE VICINITY OF RECOVERY WELLS HAVE BEEN OMITTED FOR CLARITY.

NYSPCS, L.I. ZONE, NAD 83 COORDINATES

N 204,500 —— NORTHING (Y-COORDINATE)
E 1,002,000 —— EASTING (X-COORDINATE)

100' 0 100'

Title:

REGIONAL AQUIFER GROUNDWATER ELEVATIONS MARCH 18, 2011

GREENPOINT, BROOKLYN, NEW YORK
EXXONMOBIL GREENPOINT PETROLEUM REMEDIATION PROJECT

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting and Management

Compiled by: M.R.	Date: 15MAY12	PLATE
Prepared by: G.M.	Scale: AS SHOWN	6
Project Mgr: J.P.K.	Project: 0172.0030E030	
File: 0172.0030E1875.03.DWG		

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VOCs in Soil Compared to NYSDEC Part 375 Restricted Industrial Criteria

SHALLOW ZONE

- detections below criteria

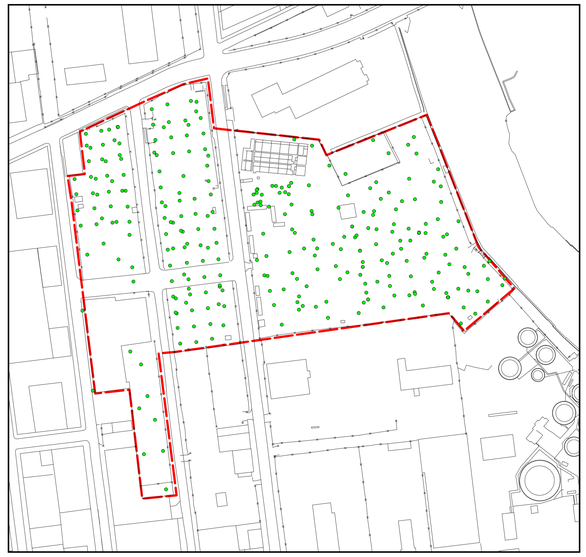
UNSATURATED ZONE

- detections below criteria
- 1 to 10 times above criteria

SATURATED ZONE

- detections below criteria

SAMPLE LOCATION MAP



VOCs in Soil Compared to NYSDEC Part 375 Protection of Groundwater Criteria

SHALLOW ZONE

- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria

UNSATURATED ZONE

- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria
- 100 to 1,000 times above criteria
- 1,000 to 10,000 times above criteria

SATURATED ZONE

- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria
- 100 to 1,000 times above criteria

SHALLOW ZONE	SOIL SAMPLES COLLECTED FROM 0 - 3 FEET BELOW LAND SURFACE
UNSATURATED ZONE	VADOSE ZONE SOIL SAMPLES COLLECTED BETWEEN 3 FEET BLS AND THE WATER TABLE
SATURATED ZONE	SOIL SAMPLES COLLECTED BELOW THE WATER TABLE
NYSDEC PART 375 PROTECTION OF GROUNDWATER CRITERIA	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 6 NYCRR PART 375 RESTRICTED USE SOIL CLEANUP OBJECTIVES FOR THE PROTECTION OF GROUNDWATER
NYSDEC PART 375 RESTRICTED INDUSTRIAL CRITERIA	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 6 NYCRR PART 375 RESTRICTED USE SOIL CLEANUP OBJECTIVES FOR INDUSTRIAL PROPERTIES

detections below criteria	LOCATIONS WHERE ONE OR MORE VOC COMPOUND WAS DETECTED BELOW NYSDEC SOIL CRITERIA
1 to 10 times above criteria	LOCATIONS WHERE ONE OR MORE VOC EXCEEDED NYSDEC SOIL CRITERIA BY 1 TO 10 TIMES THE STANDARD
10 to 100 times above criteria	LOCATIONS WHERE ONE OR MORE VOC EXCEEDED NYSDEC SOIL CRITERIA BY 10 TO 100 TIMES THE STANDARD
100 to 1000 times above criteria	LOCATIONS WHERE ONE OR MORE VOC EXCEEDED NYSDEC SOIL CRITERIA BY 100 TO 1000 TIMES THE STANDARD
1,000 to 10,000 times above criteria	LOCATIONS WHERE ONE OR MORE VOC EXCEEDED NYSDEC SOIL CRITERIA BY 1,000 TO 10,000 TIMES THE STANDARD
SOIL SAMPLING LOCATION	
ug/kg	MICROGRAMS PER KILOGRAM

NOTE:

SAMPLES FROM ALL THREE DEPTH ZONES WERE NOT NECESSARILY COLLECTED AT ALL SAMPLING LOCATIONS.

N

Title:

VOC EXCEEDANCES IN SOIL RELATIVE TO NYSDEC CRITERIA

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by:	B.P.	Date:	03FEB2012
Prepared by:	B.P.	Scale:	NTS
Project Mgr:	C.P.	Project:	0172.0030Y030
File No: 0172.0030E1875.117.WOR			

PLATE 7

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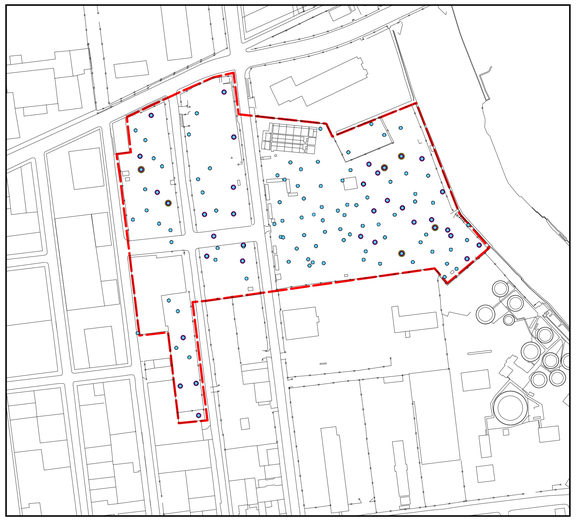
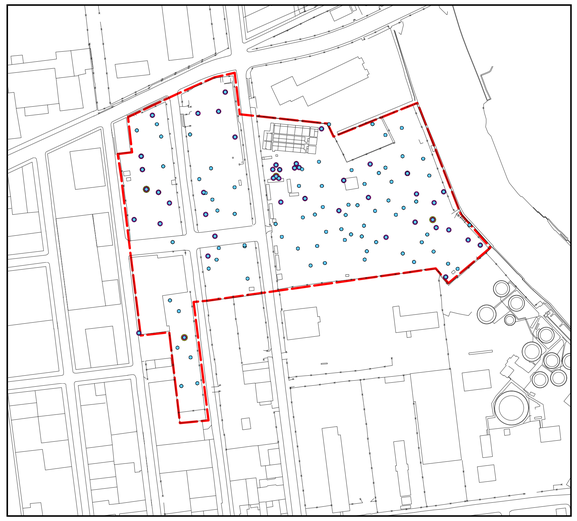
SVOCs in Soil Compared to NYSDEC Part 375 Industrial Criteria

SHALLOW ZONE



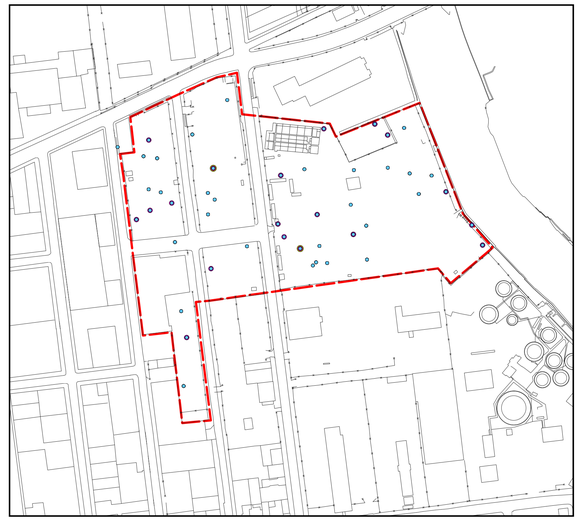
- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria

UNSATURATED ZONE



- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria

SATURATED ZONE

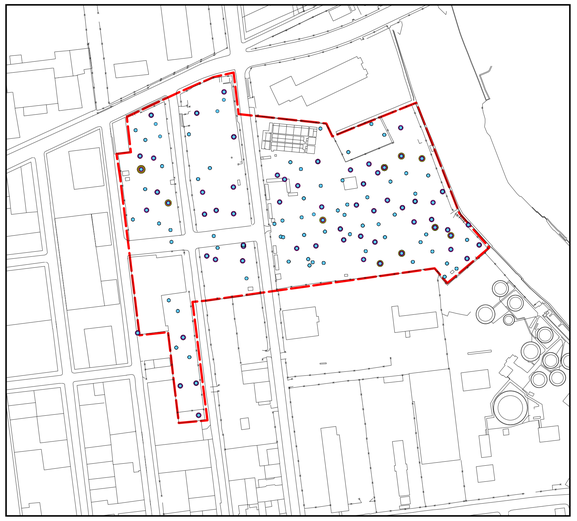


- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria

SAMPLE LOCATION MAP

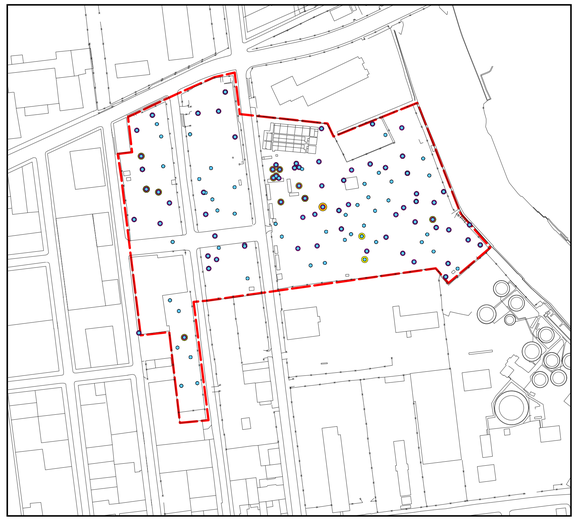
SVOCs in Soil Compared to NYSDEC Part 375 Protection of Groundwater Criteria

SHALLOW ZONE



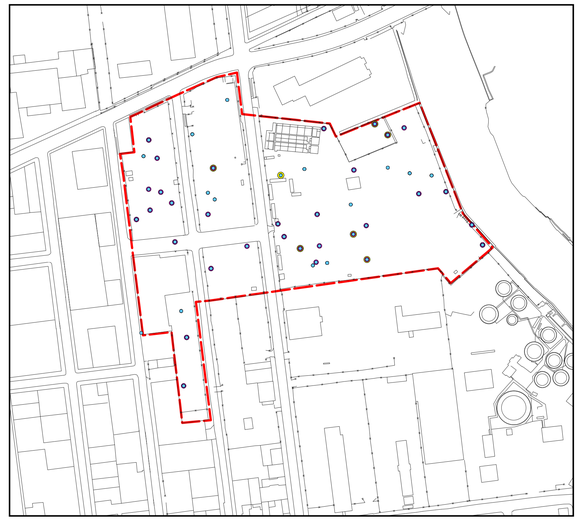
- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria
- 100 to 1000 times above criteria

UNSATURATED ZONE



- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria
- 100 to 1000 times above criteria

SATURATED ZONE



- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria

SHALLOW ZONE	SOIL SAMPLES COLLECTED FROM 0 - 3 FEET BELOW LAND SURFACE
UNSATURATED ZONE	VADOSE ZONE SOIL SAMPLES COLLECTED BETWEEN 3 FEET BLS AND THE WATER TABLE
SATURATED ZONE	SOIL SAMPLES COLLECTED BELOW THE WATER TABLE
NYSDEC PART 375 PROTECTION OF GROUNDWATER CRITERIA	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 6 NYCRR PART 375 RESTRICTED USE SOIL CLEANUP OBJECTIVES FOR THE PROTECTION OF GROUNDWATER
NYSDEC PART 375 RESTRICTED INDUSTRIAL CRITERIA	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 6 NYCRR PART 375 RESTRICTED USE SOIL CLEANUP OBJECTIVES FOR INDUSTRIAL PROPERTIES

detections below criteria	LOCATIONS WHERE ONE OR MORE SVOC COMPOUND WAS DETECTED BELOW NYSDEC SOIL CRITERIA
1 to 10 times above criteria	LOCATIONS WHERE ONE OR MORE SVOC EXCEEDED NYSDEC SOIL CRITERIA BY 1 TO 10 TIMES THE STANDARD
10 to 100 times above criteria	LOCATIONS WHERE ONE OR MORE SVOC EXCEEDED NYSDEC SOIL CRITERIA BY 10 TO 100 TIMES THE STANDARD
100 to 1000 times above criteria	LOCATIONS WHERE ONE OR MORE SVOC EXCEEDED NYSDEC SOIL CRITERIA BY 100 TO 1000 TIMES THE STANDARD
1,000 to 10,000 times above criteria	LOCATIONS WHERE ONE OR MORE SVOC EXCEEDED NYSDEC SOIL CRITERIA BY 1,000 TO 10,000 TIMES THE STANDARD

	SOIL SAMPLING LOCATION
ug/kg	MICROGRAMS PER KILOGRAM

NOTE:

SAMPLES FROM ALL THREE DEPTH ZONES WERE NOT NECESSARILY COLLECTED AT ALL SAMPLING LOCATIONS.

N

Title:

SVOC EXCEEDANCES IN SOIL RELATIVE TO NYSDEC CRITERIA

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: B.P. Date: 16MAY2012
Prepared by: B.P. Scale: NTS
Project Mgr: C.P. Project: 0172.0030Y030
File No: 0172.0030E1875.118.WOR

PLATE 8

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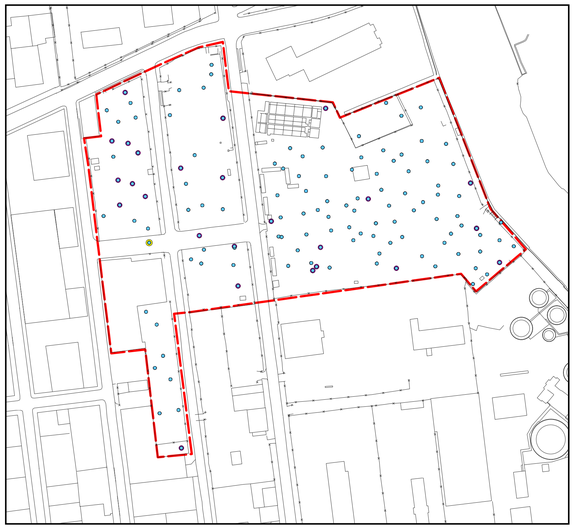
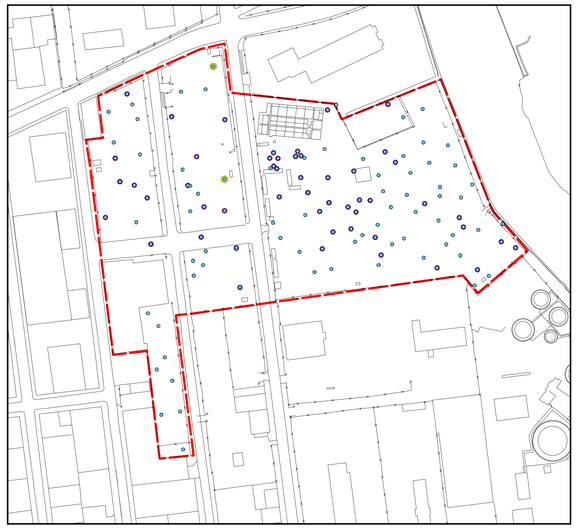
Metals in Soil Compared to NYSDEC Part 375 Restricted Industrial Criteria

SHALLOW ZONE



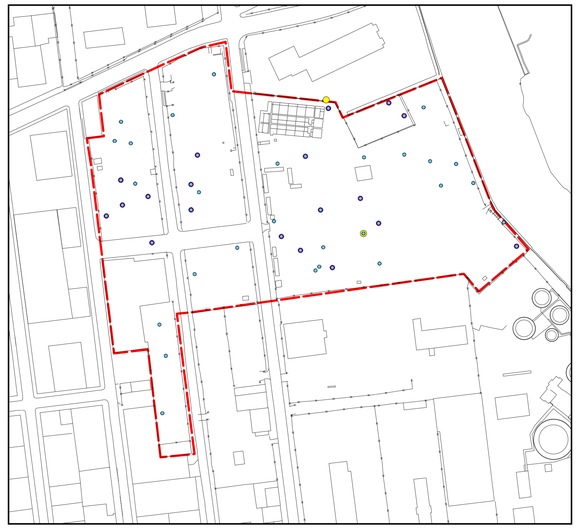
- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria

UNSATURATED ZONE



- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria

SATURATED ZONE

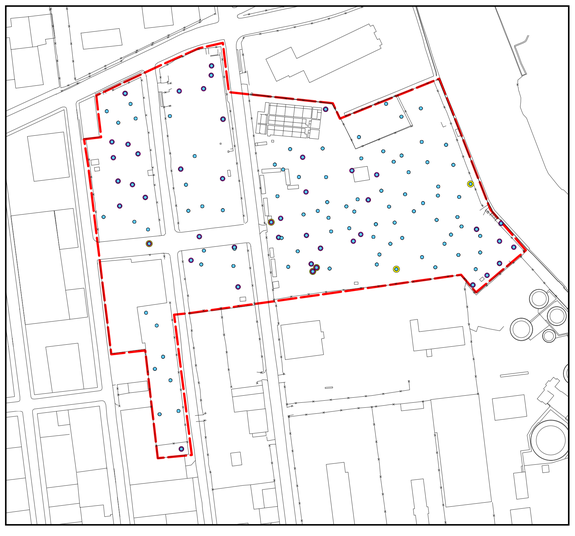


- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria

SAMPLE LOCATION MAP

Metals in Soil Compared to NYSDEC Part 375 Protection of Groundwater Criteria

SHALLOW ZONE

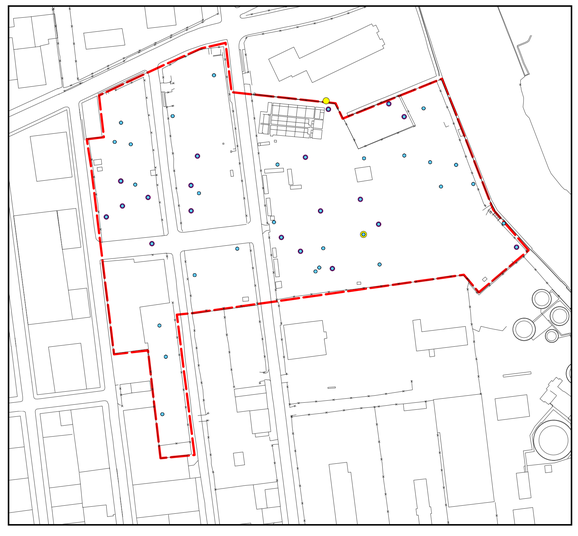


- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria

UNSATURATED ZONE

- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria
- 100 to 1,000 times above criteria

SATURATED ZONE



- detections below criteria
- 1 to 10 times above criteria
- 10 to 100 times above criteria

SHALLOW ZONE	SOIL SAMPLES COLLECTED FROM 0 - 3 FEET BELOW LAND SURFACE
UNSATURATED ZONE	VADOSE ZONE SOIL SAMPLES COLLECTED BETWEEN 3 FEET BLS AND THE WATER TABLE
SATURATED ZONE	SOIL SAMPLES COLLECTED BELOW THE WATER TABLE
NYSDEC PART 375 PROTECTION OF GROUNDWATER CRITERIA	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 6 NYCRR PART 375 RESTRICTED USE SOIL CLEANUP OBJECTIVES FOR THE PROTECTION OF GROUNDWATER
NYSDEC PART 375 RESTRICTED INDUSTRIAL CRITERIA	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 6 NYCRR PART 375 RESTRICTED USE SOIL CLEANUP OBJECTIVES FOR INDUSTRIAL PROPERTIES

detections below criteria	LOCATIONS WHERE ONE OR MORE METAL WAS DETECTED BELOW NYSDEC SOIL CRITERIA
1 to 10 times above criteria	LOCATIONS WHERE ONE OR MORE METAL EXCEEDED NYSDEC SOIL CRITERIA BY 1 TO 10 TIMES THE STANDARD
10 to 100 times above criteria	LOCATIONS WHERE ONE OR MORE METAL EXCEEDED NYSDEC SOIL CRITERIA BY 10 TO 100 TIMES THE STANDARD
100 to 1000 times above criteria	LOCATIONS WHERE ONE OR MORE METAL EXCEEDED NYSDEC SOIL CRITERIA BY 100 TO 1000 TIMES THE STANDARD
1,000 to 10,000 times above criteria	LOCATIONS WHERE ONE OR MORE METAL EXCEEDED NYSDEC SOIL CRITERIA BY 1,000 TO 10,000 TIMES THE STANDARD

SOIL SAMPLING LOCATION

mg/kg MILLIGRAMS PER KILOGRAM

NOTE:

SAMPLES FROM ALL THREE DEPTH ZONES WERE NOT NECESSARILY COLLECTED AT ALL SAMPLING LOCATIONS.

N

Title:

METAL EXCEEDANCES IN SOIL RELATIVE TO NYSDEC CRITERIA

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC.
Environmental Consulting & Management

Compiled by:	B.P.	Date: 17MAY2012	PLATE
Prepared by:	B.P.	Scale: NTS	9
Project Mgr:	C.P.	Project: 0172.0030Y030	
File No:0172.0030E1675.119.WOR			

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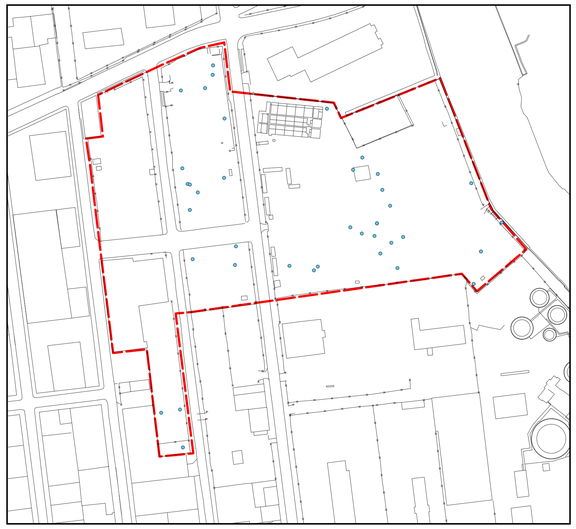
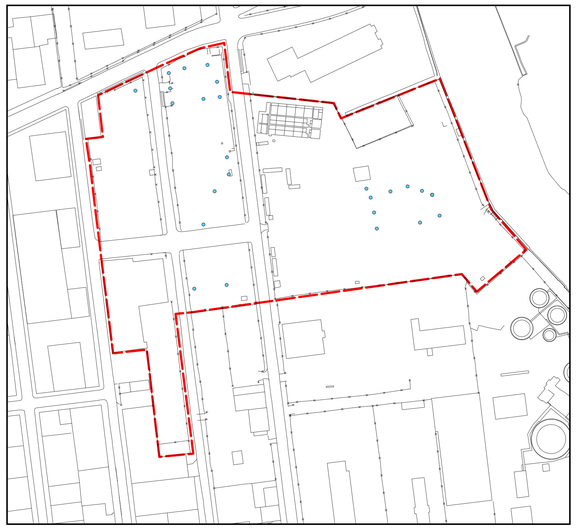
PCBs in Soil Compared to NYSDEC Part 375 Restricted Industrial Criteria

SHALLOW ZONE



detections below criteria

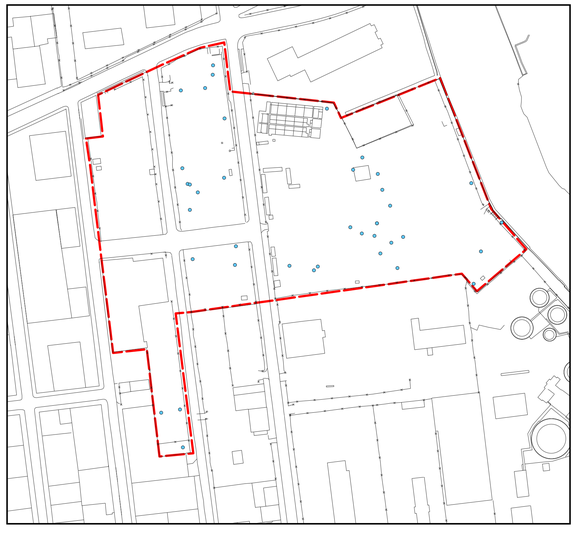
UNSATURATED ZONE



detections below criteria

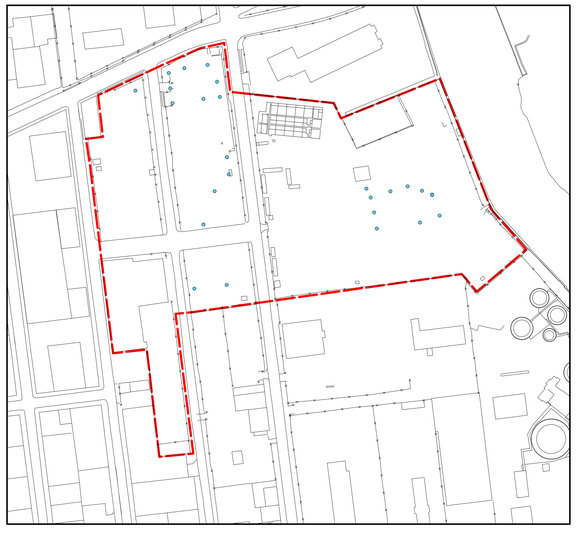
PCBs in Soil Compared to NYSDEC Part 375 Protection of Groundwater Criteria

SHALLOW ZONE



detections below criteria

UNSATURATED ZONE



detections below criteria

SAMPLE LOCATION MAP

SHALLOW ZONE	SOIL SAMPLES COLLECTED FROM 0 - 3 FEET BELOW LAND SURFACE
UNSATURATED ZONE	VADOSE ZONE SOIL SAMPLES COLLECTED BETWEEN 3 FEET BLS AND THE WATER TABLE
NYSDEC PART 375 PROTECTION OF GROUNDWATER CRITERIA	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 6 NYCRR PART 375 RESTRICTED USE SOIL CLEANUP OBJECTIVES FOR THE PROTECTION OF GROUNDWATER
NYSDEC PART 375 RESTRICTED INDUSTRIAL CRITERIA	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION 6 NYCRR PART 375 RESTRICTED USE SOIL CLEANUP OBJECTIVES FOR INDUSTRIAL PROPERTIES

detections below criteria	LOCATIONS WHERE ONE OR MORE METAL WAS DETECTED BELOW NYSDEC SOIL CRITERIA
1 to 10 times above criteria	LOCATIONS WHERE ONE OR MORE METAL EXCEEDED NYSDEC SOIL CRITERIA BY 1 TO 10 TIMES THE STANDARD
10 to 100 times above criteria	LOCATIONS WHERE ONE OR MORE METAL EXCEEDED NYSDEC SOIL CRITERIA BY 10 TO 100 TIMES THE STANDARD
100 to 1000 times above criteria	LOCATIONS WHERE ONE OR MORE METAL EXCEEDED NYSDEC SOIL CRITERIA BY 100 TO 1000 TIMES THE STANDARD
1,000 to 10,000 times above criteria	LOCATIONS WHERE ONE OR MORE METAL EXCEEDED NYSDEC SOIL CRITERIA BY 1,000 TO 10,000 TIMES THE STANDARD

	SOIL SAMPLING LOCATION
ug/kg	MICROGRAMS PER KILOGRAM
PCBs	POLYCHLORINATED BIPHENYLS

NOTE:
SAMPLES FROM BOTH DEPTH ZONES WERE NOT NECESSARILY COLLECTED AT ALL SAMPLING LOCATIONS.

N

Title:
PCB EXCEEDANCES IN SOIL RELATIVE TO NYSDEC CRITERIA

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by:	B.P.	Date:	17MAY2012
Prepared by:	B.P.	Scale:	NTS
Project Mgr:	C.P.	Project:	0172.0030Y030
File: N:\0172.0030\E1875.120.WOR			

PLATE
10

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E 999,500
E 1,000,000
E 1,000,500
E 1,001,000
E 1,001,500
N 206,000
N 205,500
N 205,000
N 204,500

GREENPOINT AVENUE
CALYER STREET
MESEROLE AVENUE
NORMAN AVENUE
RUSSELL STREET
NORTH HENRY STREET
MONITOR STREET
KINGSLAND AVENUE
NEWTOWN CREEK
BRIDGEWATER STREET
HAUSMAN STREET
APOLLO STREET
VAN DAM STREET
VARICK ST

FORMER BROOKLYN TERMINAL
NORTH HENRY YARD

FORMER BROOKLYN TERMINAL
MONITOR STREET YARD

FORMER BROOKLYN TERMINAL
KINGSLAND AVENUE YARD

S-63 NM
NCM-4/S ND
S-45 NM
W-44 ND
W-52 ND
S-10 ND
S-28 ND
S-69 NM
S-67 NM
S-15 NM
W-35 NM
NCM-11/S ND
S-44 ND
S-46 ND
S-11 ND
W-79 ND
RW-13 NM
S-30 ND
S-39 ND
S-22 ND
S-19 ND
S-51 ND
S-14 ND
S-20 ND
S-55 0.03
RW-15 ND
RW-1 NM
S-12 ND
S-21 ND
S-45 ND
S-58 ND
S-13 ND
S-70 ND
S-23 ND
S-47 NM
S-48 0.17
NCM-14/S ND
S-27 ND
S-66 0.26
S-16 ND
S-24 ND
S-73 ND
S-72 0.27
S-17 ND
S-33 1.24
W-32 ND
S-68 NM
S-57 ND
S-54 NM
S-26 ND
S-40 ND
S-74 ND
S-29 ND
S-41 ND
W-12 ND
S-18 ND
S-2 ND
S-1 ND
S-56R NM
NCM-15/S NM
W-1 ND
S-49 NM
S-50 NM

LEGEND

- FORMER EXXONMOBIL BROOKLYN TERMINAL
- S-33 / 0.27 — LOCATION AND DESIGNATION OF EXISTING SHALLOW AQUIFER MONITORING WELL WITH MEASURABLE FREE-PRODUCT FREE-PRODUCT THICKNESS IN FEET
- W-1 / ND — LOCATION AND DESIGNATION OF EXISTING SHALLOW AQUIFER MONITORING WELL WITH NO MEASURABLE FREE-PRODUCT FREE-PRODUCT THICKNESS IN FEET
- RW-15 — LOCATION AND DESIGNATION OF EXISTING SHALLOW AQUIFER RECOVERY WELL
- NCM-4/S / ND — LOCATION AND DESIGNATION OF EXISTING NYCDEP MONITORING WELL WITH CONSTRUCTION DESIGNATION (APPROXIMATE LOCATION) (S=SHALLOW AQUIFER) FREE-PRODUCT THICKNESS IN FEET
- NM — NOT MEASURED
- ND — FREE-PRODUCT NOT DETECTED

NOTES

1. BASE MAP PREPARED FROM AERIAL SURVEY PERFORMED BY ANGLE OF ATTACK LAND SURVEYING, LLC, MAY 2001. ALL TOPOGRAPHIC AND PLANIMETRIC DETAILS WERE PREPARED USING PHOTOGRAMMETRIC METHODS.
2. HORIZONTAL LOCATIONS ARE BASED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
3. ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
4. MONITORING WELLS DESIGNATED WITH AN NM FOR GROUNDWATER ELEVATION OR FREE-PRODUCT THICKNESS WERE NOT ABLE TO MEASURED DUE TO INACCESSIBILITY OF THE WELL (I.E., CARS/TRUCKS PARKED ON TOP OF WELL, WELL COVERED WITH DEBRIS AND/OR WELL COULD NOT BE LOCATED).
5. RECOVERY WELLS RW-1, RW-13, RW-15 AND RW-20 WERE NOT OPERATING AT THE TIME OF MEASUREMENT.

NYSPCS, L.I. ZONE, NAD 83 COORDINATES

N 204,500 — NORTHING (Y-COORDINATE)
E 1,002,000 — EASTING (X-COORDINATE)

100' 0 100'

Title:

SHALLOW AQUIFER APPARENT FREE-PRODUCT THICKNESS MARCH 18, 2011

GREENPOINT, BROOKLYN, NEW YORK
EXXONMOBIL GREENPOINT PETROLEUM REMEDIATION PROJECT

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting and Management

Compiled by: M.R.	Date: 15MAY12	PLATE 11
Prepared by: G.M.	Scale: AS SHOWN	
Project Mgr: J.P.K.	Project: 0172.0030E030	
File: 0172.0030E1875.05.DWG		

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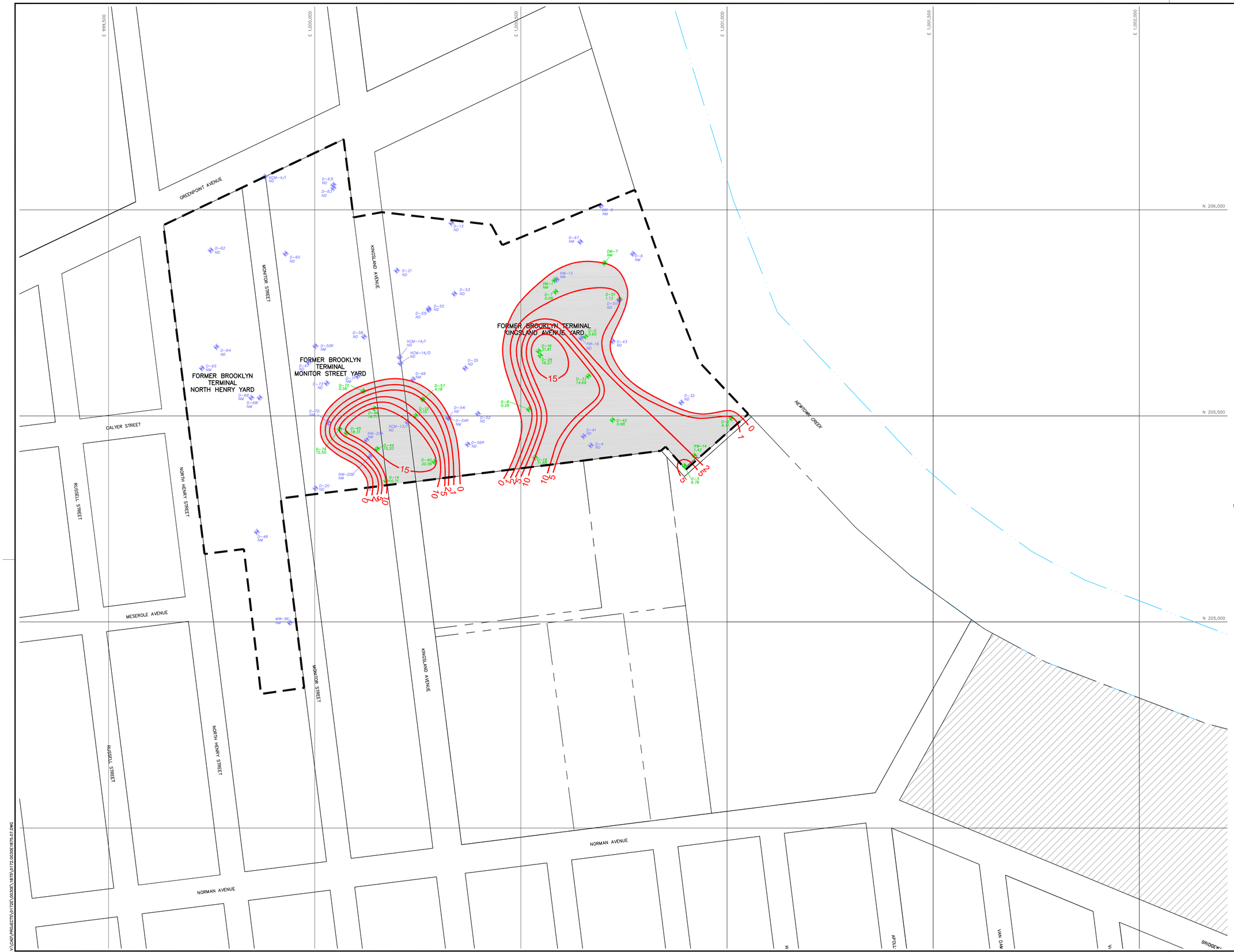

LEGEND

- FORMER EXXONMOBIL BROOKLYN TERMINAL
- D-33 / 14.69 — LOCATION AND DESIGNATION OF EXISTING REGIONAL AQUIFER (CONFINED) MONITORING WELL; FREE-PRODUCT THICKNESS IN FEET
- RW-14 / 1.42 — LOCATION AND DESIGNATION OF EXISTING REGIONAL AQUIFER RECOVERY WELL; FREE-PRODUCT THICKNESS IN FEET
- NCM-14/I / ND — LOCATION AND DESIGNATION OF EXISTING NYCDEP MONITORING WELL WITH CONSTRUCTION DESIGNATION (APPROXIMATE LOCATION) (S=SHALLOW AQUIFER, I=REGIONAL AQUIFER, D=TILL AQUIFER); FREE-PRODUCT THICKNESS IN FEET

MONITORING WELL COLOR CODE SCHEME

- BLUE — DESIGNATES MONITORING WELL WHERE NO FREE-PRODUCT WAS DETECTED
- GREEN — DESIGNATES MONITORING WELL WHERE FREE-PRODUCT WAS DETECTED
- NM — NOT MEASURED
- ND — FREE-PRODUCT NOT DETECTED
- 1 — LINE OF EQUAL FREE-PRODUCT THICKNESS, IN FEET
- APPROXIMATE EXTENT OF FREE-PRODUCT THICKNESS

NOTES

1. BASE MAP PREPARED FROM AERIAL SURVEY PERFORMED BY ANGLE OF ATTACK LAND SURVEYING, LLC, MAY 2001. ALL TOPOGRAPHIC AND PLANIMETRIC DETAILS WERE PREPARED USING PHOTOGRAMMETRIC METHODS.
2. HORIZONTAL LOCATIONS ARE BASED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
3. ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
4. MONITORING WELLS DESIGNATED WITH AN NM FOR FREE-PRODUCT THICKNESS WERE UNABLE TO BE MEASURED DUE TO INACCESSIBILITY OF THE WELL (I.E., CARS/TRUCKS PARKED ON TOP OF WELL, WELL COVERED WITH DEBRIS AND/OR WELL COULD NOT BE LOCATED)
5. FREE-PRODUCT THICKNESSES IN OPERATING RECOVERY WELLS ARE OMITTED FOR CONTOURING PURPOSES.
6. FREE-PRODUCT PRESENT IN THE REGIONAL AQUIFER BENEATH THE FORMER MOBIL BROOKLYN TERMINAL EXISTS UNDER SEMI-CONFINED CONDITIONS, RESULTING IN LARGE MONITORING WELL FREE-PRODUCT THICKNESSES THAT ARE GREATLY EXAGGERATED WITH REGARDS TO THE ACTUAL AMOUNT OF FREE-PRODUCT PRESENT. FOR THIS REASON, FREE-PRODUCT THICKNESS MEASUREMENTS AND CONTOURS SHOWN, WITHIN THE BOUNDS OF THE FORMER MOBIL BROOKLYN TERMINAL CAN ONLY BE CONSIDERED A GENERAL INDICATOR OF PRESSURE DISTRIBUTION WITHIN THE FREE-PRODUCT PHASE AND CANNOT BE USED TO DIRECTLY DETERMINE FREE-PRODUCT VOLUME OR MIGRATION CHARACTERISTICS.
7. SOME FREE-PRODUCT THICKNESS CONTOURS IN THE VICINITY OF THE FORMER MOBIL BROOKLYN TERMINAL HAVE BEEN OMITTED FOR CLARITY.
8. FREE-PRODUCT THICKNESSES WITHIN NYCDEP REGIONAL AQUIFER MONITORING WELLS WERE OMITTED FOR CONTOURING PURPOSES BASED ON WELL CONSTRUCTION INFORMATION PROVIDED BY MALCOLM PIRNIE THAT INDICATED THAT THESE WELLS WERE SCREENED BELOW THE KNOWN REGION OF FREE-PRODUCT.
9. SMALL FREE-PRODUCT THICKNESSES MEASURED IN SOME FORMER MOBIL BROOKLYN TERMINAL MONITORING WELLS WERE OMITTED FOR CONTOURING PURPOSES DUE TO THE LACK OF HYDRAULIC CONNECTION BETWEEN THOSE THICKNESSES AND FREE-PRODUCT WITHIN THE REGIONAL AQUIFER.
10. SYMBOL COLORS FOR MONITORING WELLS THAT WERE NOT MEASURED (NM DESIGNATION) DURING THIS QUARTER'S GAUGING EVENT WERE ASSIGNED BASED ON HISTORIC / RECENT GAUGING DATA THAT INDICATED THE PRESENCE OF, OR LACK OF, FREE-PRODUCT WITHIN THE ASSOCIATED MONITORING WELL.

NYSPCS, L.I. ZONE, NAD 83 COORDINATES

N 204,500 —— NORTHING (Y-COORDINATE)
E 1,002,000 —— EASTING (X-COORDINATE)

100' 0 100'

Title:

REGIONAL AQUIFER APPARENT FREE-PRODUCT THICKNESS MARCH 18, 2011

GREENPOINT, BROOKLYN, NEW YORK
EXXONMOBIL GREENPOINT PETROLEUM REMEDIATION PROJECT

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting and Management

Compiled by: M.R.	Date: 15MAY12	PLATE
Prepared by: G.M.	Scale: AS SHOWN	12
Project Mgr: J.P.K.	Project: 0172.0030E030	
File: 0172.0030E1875.07.DWG		

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LEGEND

- FORMER EXXONMOBIL BROOKLYN TERMINAL
- D-33 / 14.69 — LOCATION AND DESIGNATION OF EXISTING REGIONAL AQUIFER (CONFINED) MONITORING WELL; FREE-PRODUCT THICKNESS IN FEET
- RW-14 / 1.42 — LOCATION AND DESIGNATION OF EXISTING REGIONAL AQUIFER RECOVERY WELL; FREE-PRODUCT THICKNESS IN FEET
- NCM-14/I / ND — LOCATION AND DESIGNATION OF EXISTING NYCDEP MONITORING WELL WITH CONSTRUCTION DESIGNATION (APPROXIMATE LOCATION) (S=SHALLOW AQUIFER, I=REGIONAL AQUIFER, D=TILL AQUIFER); FREE-PRODUCT THICKNESS IN FEET

MONITORING WELL COLOR CODE SCHEME

- BLUE — DESIGNATES MONITORING WELL WHERE NO FREE-PRODUCT WAS DETECTED
- GREEN — DESIGNATES OFF-SITE / ON-SITE / BP MONITORING WELL WHERE FREE-PRODUCT WAS DETECTED
- NM — NOT MEASURED
- ND — FREE-PRODUCT NOT DETECTED
- 1 — LINE OF EQUAL FREE-PRODUCT THICKNESS, IN FEET
- APPROXIMATE EXTENT OF FREE-PRODUCT THICKNESS

NOTES

1. BASE MAP PREPARED FROM AERIAL SURVEY PERFORMED BY ANGLE OF ATTACK LAND SURVEYING, LLC, MAY 2001. ALL TOPOGRAPHIC AND PLANIMETRIC DETAILS WERE PREPARED USING PHOTOGRAMMETRIC METHODS.
2. HORIZONTAL LOCATIONS ARE BASED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
3. ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
4. MONITORING WELLS DESIGNATED WITH AN NM FOR FREE-PRODUCT THICKNESS WERE UNABLE TO BE MEASURED DUE TO INACCESSIBILITY OF THE WELL (I.E., CARS/TRUCKS PARKED ON TOP OF WELL, WELL COVERED WITH DEBRIS AND/OR WELL COULD NOT BE LOCATED)
5. FREE-PRODUCT THICKNESSES IN OPERATING RECOVERY WELLS ARE OMITTED FOR CONTOURING PURPOSES.
6. SOME FREE-PRODUCT THICKNESS CONTOURS IN THE VICINITY OF THE FORMER MOBIL BROOKLYN TERMINAL HAVE BEEN OMITTED FOR CLARITY.
7. FREE-PRODUCT THICKNESSES WITHIN NYCDEP REGIONAL AQUIFER MONITORING WELLS WERE OMITTED FOR CONTOURING PURPOSES BASED ON WELL CONSTRUCTION INFORMATION PROVIDED BY MALCOLM PIRNIE THAT INDICATED THAT THESE WELLS WERE SCREENED BELOW THE KNOWN REGION OF FREE-PRODUCT.
8. SMALL FREE-PRODUCT THICKNESSES MEASURED IN SOME FORMER MOBIL BROOKLYN TERMINAL MONITORING WELLS WERE OMITTED FOR CONTOURING PURPOSES DUE TO THE LACK OF HYDRAULIC CONNECTION BETWEEN THOSE THICKNESSES AND FREE-PRODUCT WITHIN THE REGIONAL AQUIFER.
9. SYMBOL COLORS FOR MONITORING WELLS THAT WERE NOT MEASURED (NM DESIGNATION) DURING THIS QUARTER'S GAUGING EVENT WERE ASSIGNED BASED ON HISTORIC / RECENT GAUGING DATA THAT INDICATED THE PRESENCE OF, OR LACK OF, FREE-PRODUCT WITHIN THE ASSOCIATED MONITORING WELL.
10. THE CORRECTED FORMATION FREE-PRODUCT THICKNESS UNDER CONFINED CONDITIONS IS EQUAL TO THE VERTICAL DISTANCE BETWEEN THE BASE OF THE SHALLOW CONFINING UNIT AND THE OIL/WATER INTERFACE IN THE MONITORING WELL.

NYSPCS, L.I. ZONE, NAD 83 COORDINATES

N 204,500 —— NORTHING (Y-COORDINATE)
E 1,002,000 —— EASTING (X-COORDINATE)

100' 0 100'

Title:

REGIONAL AQUIFER CORRECTED FREE-PRODUCT THICKNESS MARCH 18, 2011

GREENPOINT, BROOKLYN, NEW YORK
EXXONMOBIL GREENPOINT PETROLEUM REMEDIATION PROJECT

Prepared For: EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting and Management

Compiled by: M.R.	Date: 15MAY12	PLATE
Prepared by: G.M.	Scale: AS SHOWN	
Project Mgr: J.P.K.	Project: 0172.0030E030	13
File: 0172.0030E1875.06.DWG		

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NORTH HENRY ST

MONITOR ST

KINGSLAND AVE

CALYER ST

NEWTOWN CREEK

LEGEND

	INDICATES LOCATIONS WHERE THE TOTAL BTEX CONCENTRATION WAS DETECTED BELOW THE LOWEST NYSDEC AWQSGV FOR INDIVIDUAL BTEX COMPOUNDS (I.E., BENZENE STANDARD OF 1 UG/L)
	FORMER EXXONMOBIL BROOKLYN TERMINAL
BTEX	BENZENE, TOLUENE, ETHYLBENZENE AND TOTAL XYLENES
UG/L	MICROGRAMS PER LITER
NYSDEC AWGSGVS	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES FOR CLASS GA GROUNDWATER

BTEX Ranges (in ug/L)

0 to	1
1 to	10
10 to	100
100 to	1,000
1,000 to	10,000
10,000 to	100,000

NOTE:

THE DATA SHOWN IS BASED ON THE MOST RECENT TOTAL BTEX CONCENTRATION DETECTED IN GROUNDWATER AT EACH LOCATION AS OF FEBRUARY 2011.

N

Title:

TOTAL BTEX CONCENTRATIONS IN GROUNDWATER

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX
ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: B.P.	Date: 17MAY2012
Prepared by: B.P.	Scale: 1" = 75'
Project Mgr: C.P.	Project: 0172.0030Y030
File No: 0172.0030E1875.122.WOR	

PLATE **14**

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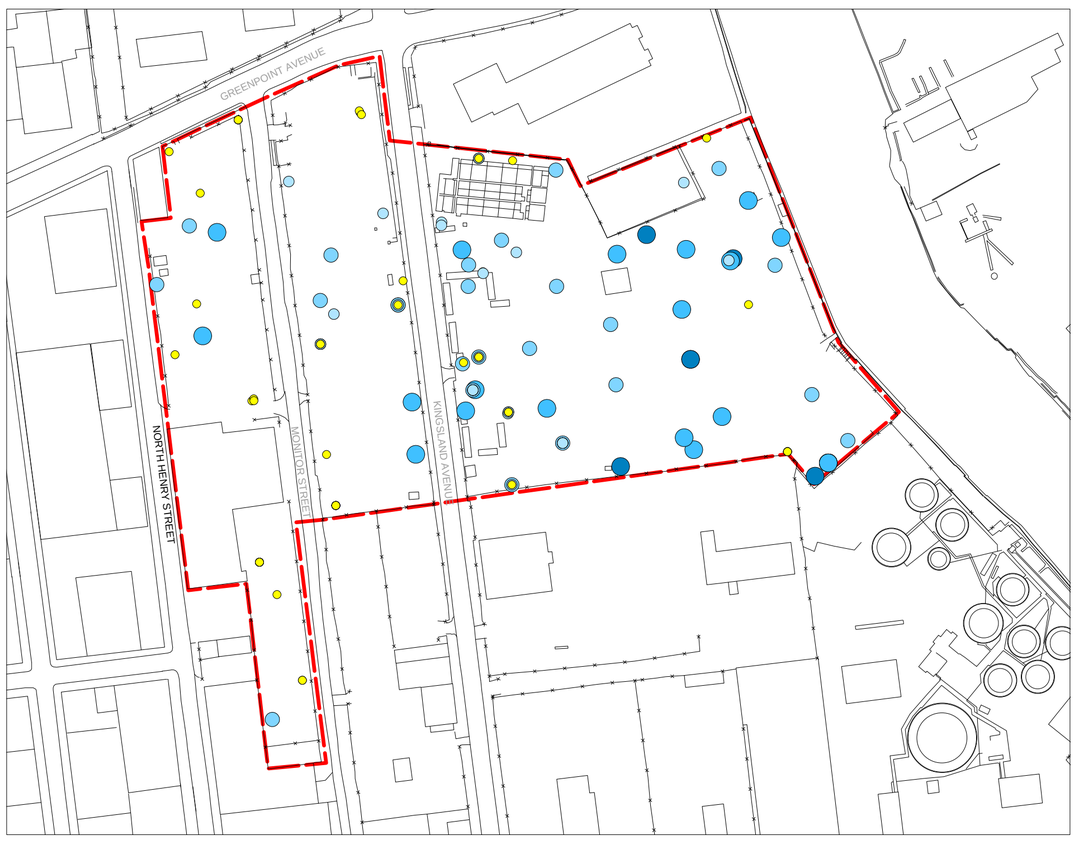
CONCENTRATIONS OF INDIVIDUAL BTEX COMPOUNDS IN GROUNDWATER

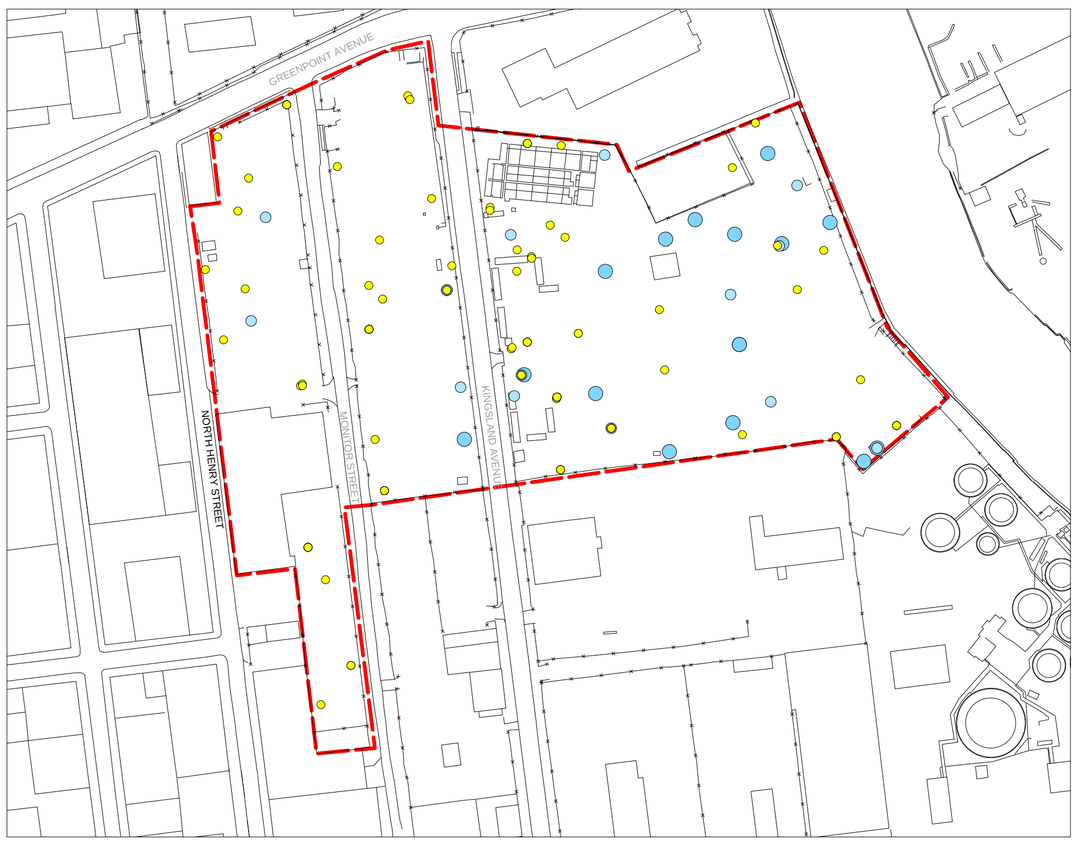
BENZENE



Benzene Concentration
Standard = 1 ug/L

0 to	1
1 to	10
10 to	100
100 to	1,000
1,000 to	10,000
10,000 to	100,000

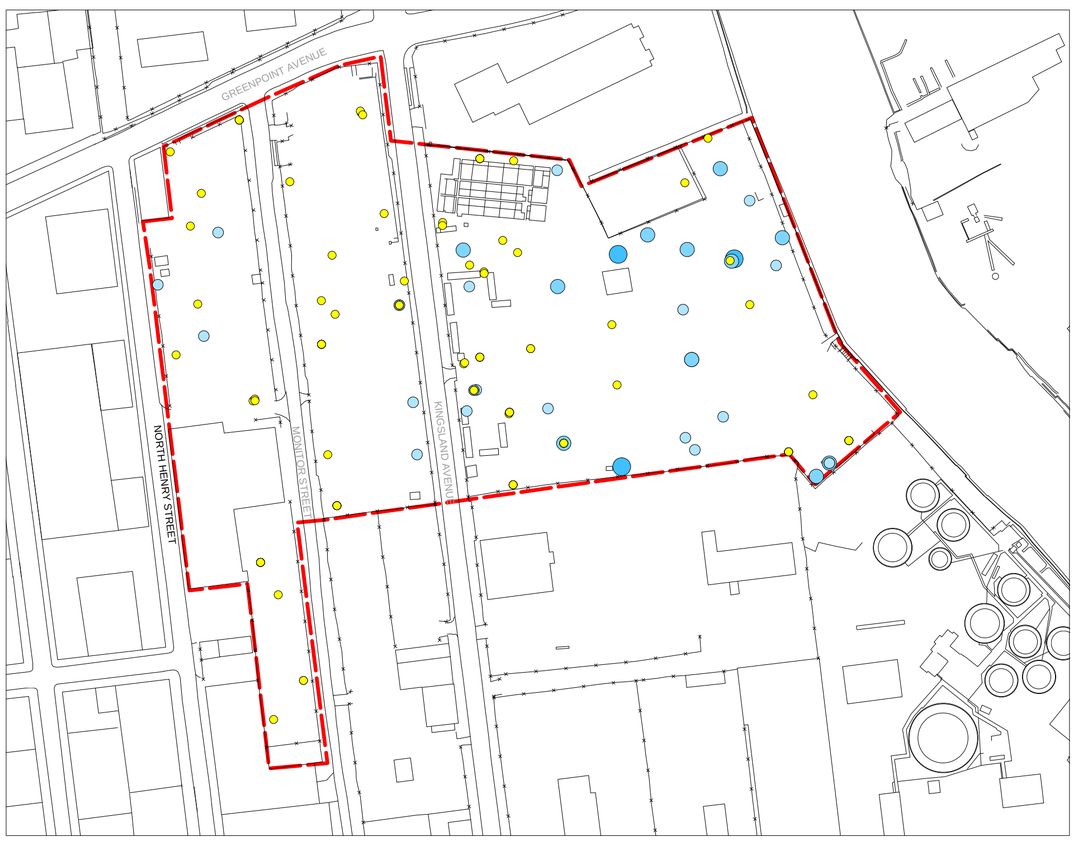
ETHYLBENZENE



Ethylbenzene Concentration
Standard = 5 ug/L

0 to	5
5 to	50
50 to	500
500 to	5,000

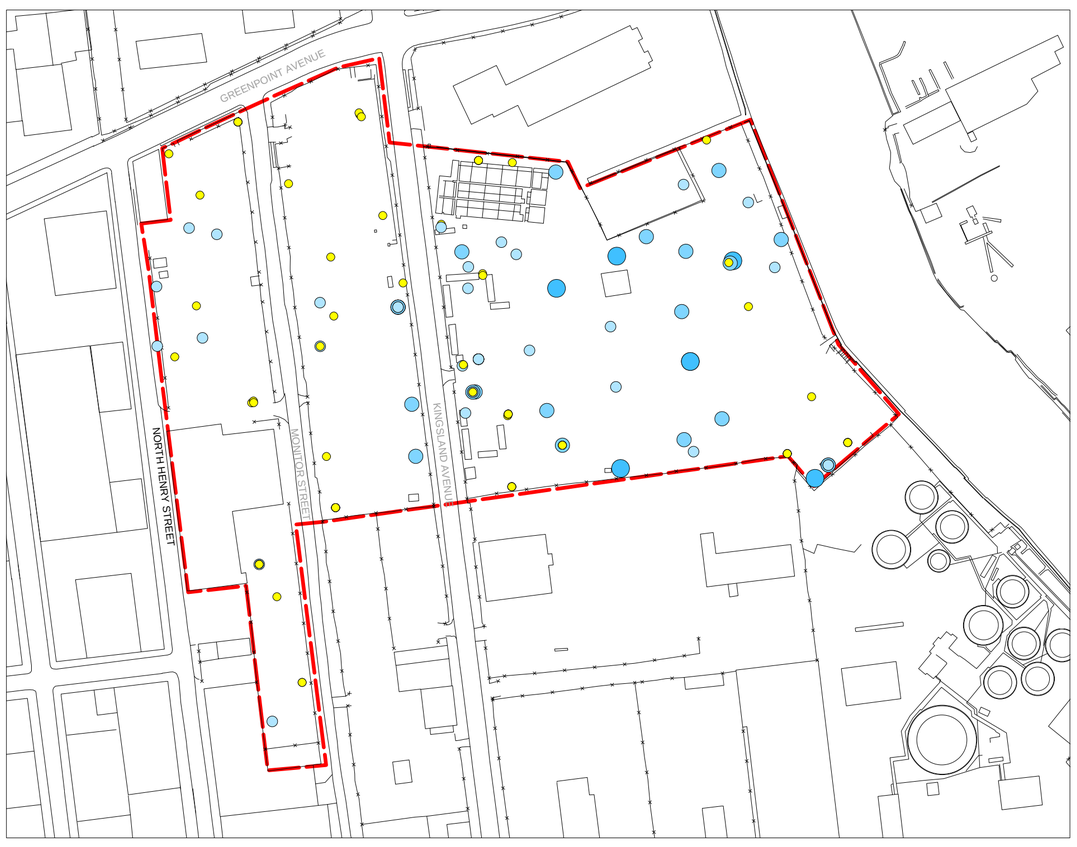
TOLUENE



Toluene Concentration
Standard = 5 ug/L

0 to	5
5 to	50
50 to	500
500 to	5,000
5,000 to	50,000

XYLENES (TOTAL)



Total Xylene Concentration
Standard = 5 ug/L

0 to	5
5 to	50
50 to	500
500 to	5,000
5,000 to	50,000

LEGEND

FORMER EXXONMOBIL BROOKLYN TERMINAL

INDICATES LOCATIONS WITH CONCENTRATIONS BELOW AWQSGVs

UG/L MICROGRAMS PER LITER

NOTE:

BENZENE, TOLUENE, ETHYLBENZENE AND TOTAL XYLENE CONCENTRATIONS ARE COMPARED TO NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES (AWQSGVs) FOR CLASS GA GROUNDWATER.

N

Title:

BENZENE, ETHYLBENZENE, TOLUENE AND XYLENES ABOVE AWQSGVs IN GROUNDWATER

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: B.P.	Date: 17MAY2012
Prepared by: B.P.	Scale: 1" = 200'
Project Mgr: C.P.	Project: 0172.0030Y030
File No: 0172.0030E1875.123.WOR	

PLATE
15

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SVOCs IN GROUNDWATER

1,2-Dichlorobenzene

1,2-Dichlorobenzene Concentration
Standard = 3 ug/L

- 0 to 3
- 3 to 30

2,4-Dimethylphenol

2,4-Dimethylphenol Concentration
Standard = 50 ug/L

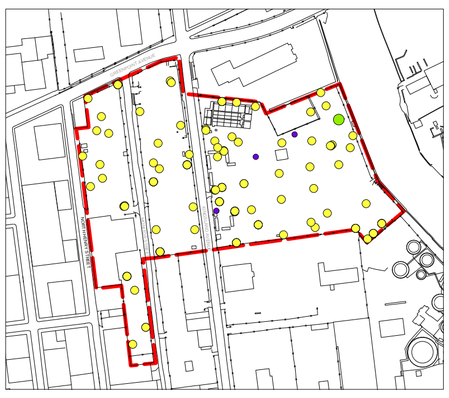
- 0 to 50
- 50 to 500
- 500 to 5,000
- 5,000 to 50,000

Acenaphthene

Acenaphthene Concentration
Standard = 20 ug/L

- 0 to 20
- 20 to 200
- 200 to 2,000

Acenaphthelene



Acenaphthylene Concentration
Standard = 20 ug/L

- 0 to 20
- 20 to 200

Anthracene

Anthracene Concentration
Standardard = 50 ug/L

- 0 to 50
- 50 to 500

Benzo[a]anthracene

Benzo[a]anthracene Concentration
Standard = 0.002 ug/L

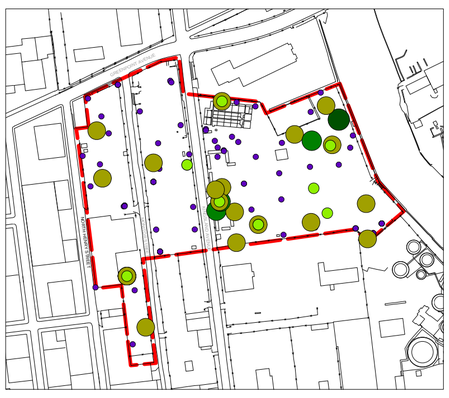
- 0 to 0.002
- 0.002 to 2
- 2 to 20
- 20 to 200
- 200 to 2,000

Benzo[a]pyrene

Benzo[a]pyrene Concentration
Standard = 0 ug/L

- 0 to 10
- 10 to 100
- 100 to 1,000

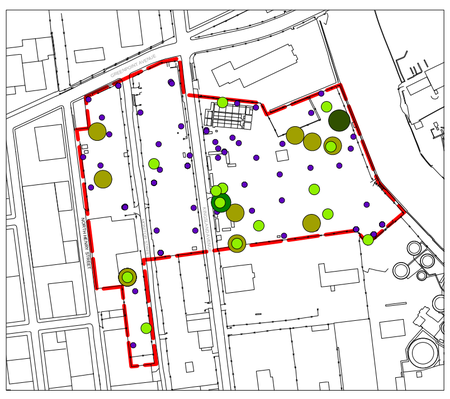
Benzo[b]fluoranthene



Benzo[b]fluoranthene Concentration
Standard = 0.002 ug/L

- 0 to 0.002
- 0.002 to 2
- 2 to 20
- 20 to 200
- 200 to 2,000

Benzo[k]fluoranthene



Benzo[k]fluoranthene Concentration
Standard = 0.002 ug/L

- 0 to 0.002
- 0.002 to 2
- 2 to 20
- 20 to 200
- 200 to 2,000

Bis-2-ethylhexylphthalate

Bis-2-ethylhexylphthalate Concentration
Standard = 1 ug/L

- 0 to 1
- 1 to 10
- 10 to 100
- 100 to 1,000

Chrysene

Chrysene Concentration
Standard = 0.002 ug/L

- 0 to 0.002
- 0.002 to 2
- 2 to 20
- 20 to 200
- 200 to 2,000

Fluoranthene

Fluoranthene Concentration
Standard = 50 ug/L

- 0 to 50
- 50 to 500
- 500 to 5,000

Fluorene

Fluorene Concentration
Standard = 50 ug/L

- 0 to 50
- 50 to 500
- 500 to 5,000

Indeno[1,2,3-cd]pyrene

Indeno[1,2,3-cd]pyrene Concentration
Standard = 0.002 ug/L

- 0 to 0.002
- 0.002 to 2
- 2 to 20
- 20 to 200

Naphthalene

Naphthalene Concentration
Standard = 10 ug/L

- 0 to 10
- 10 to 100
- 100 to 1,000
- 1,000 to 10,000

Phenanthrene

Phenanthrene Concentration
Standard = 50 ug/L

- 0 to 50
- 50 to 500
- 500 to 5,000

Phenol

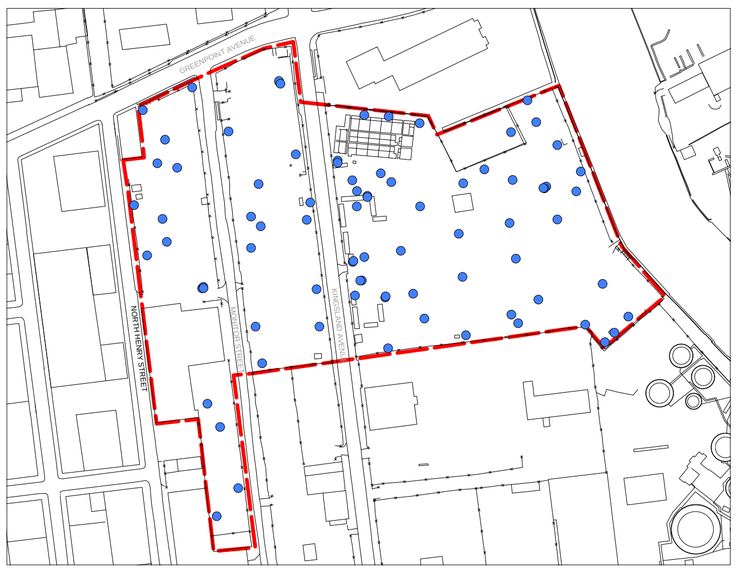
Phenol Concentration
Standard = 1 ug/L

- 0 to 1
- 1 to 10
- 10 to 100
- 100 to 1,000

Pyrene

Pyrene Concentration
Standard = 50 ug/L

- 0 to 50
- 50 to 500
- 500 to 5,000



SAMPLING LOCATIONS

LEGEND

- INDICATES SAMPLE LOCATIONS WITH SVOC CONCENTRATIONS BELOW THEIR RESPECTIVE REGULATORY STANDARDS.
- INDICATES SAMPLE LOCATIONS WHERE THE LABORATORY REPORTING LIMIT EXCEEDED THE REGULATORY STANDARD FOR A PARTICULAR COMPOUND.
- FORMER EXXONMOBIL BROOKLYN TERMINAL
- UG/L MICROGRAMS PER LITER

NOTES:

1. CONCENTRATIONS OF EACH COMPOUND ARE COMPARED TO NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES (AWQSGVS) FOR CLASS GA GROUNDWATER.

2. SVOCS SHOWN WERE SELECTED BASED UPON AT LEAST ONE EXCEEDANCE OF THEIR RESPECTIVE AWQSGVS.

N

Title:

SVOCs ABOVE AWQSGVS FOR CLASS GA GROUNDWATER

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC
Environmental Consulting & Management

Compiled by: B.P.	Date: 17MAY2012
Prepared by: B.P.	Scale: NOT TO SCALE
Project Mgr: C.P.	Project: 0172.0030Y030
File No: 0172.0030E1875.124.WOR	

PLATE 16

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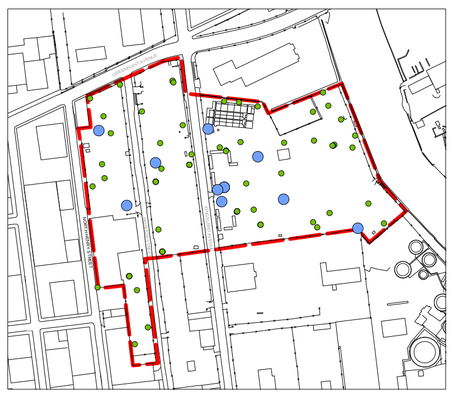
METALS IN GROUNDWATER

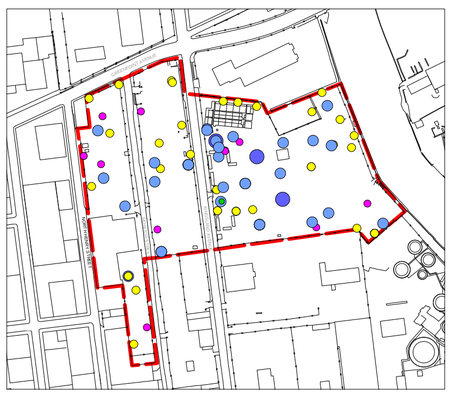
ANTIMONY *



Antimony by Concentration
Standard = 3 ug/L

- ND
- >ND to 3
- 3 to 30
- 30 to 300

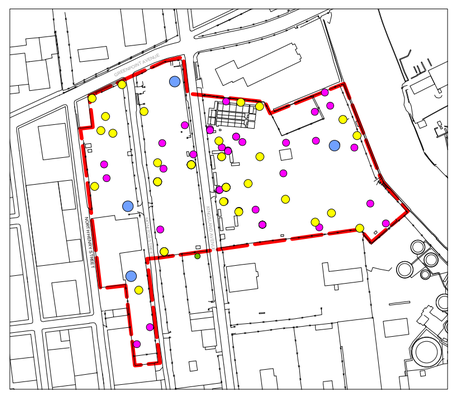
ARSENIC



Arsenic by Concentration
Standard = 25 ug/L

- ND
- >ND to 25
- 25 to 250
- 250 to 2,500

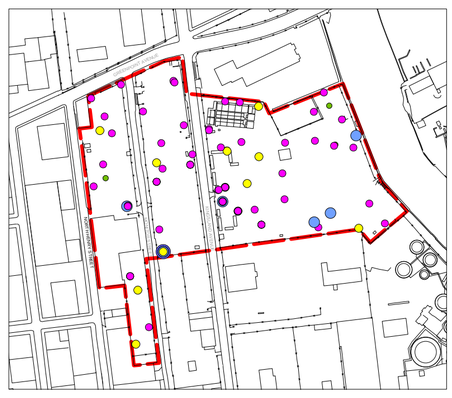
BARIUM *



Barium by Concentration
Standard = 1,000 ug/L

- ND
- >ND to 1,000
- 1,000 to 10,000
- 10,000 to 100,000

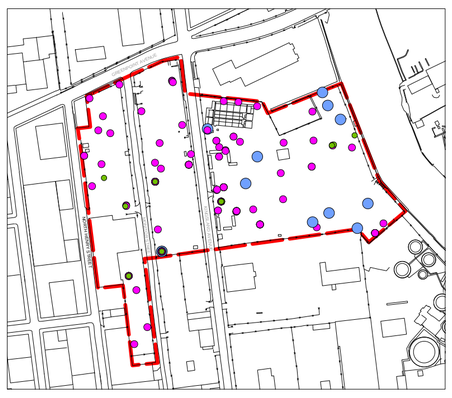
BERYLLIUM *



Beryllium by Concentration
Standard = 3ug/L

- ND
- >ND to 3
- 3 to 30
- 30 to 300

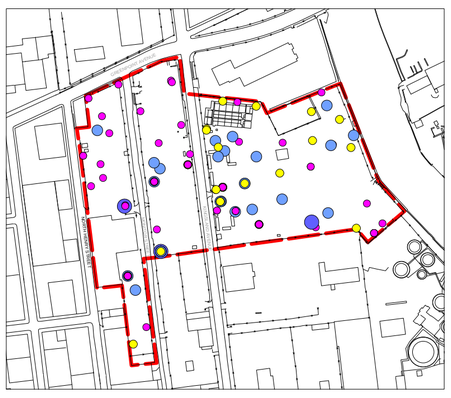
CADMIUM



Cadmium by Concentration
Standard = 5ug/L

- ND
- >ND to 5
- 5 to 50

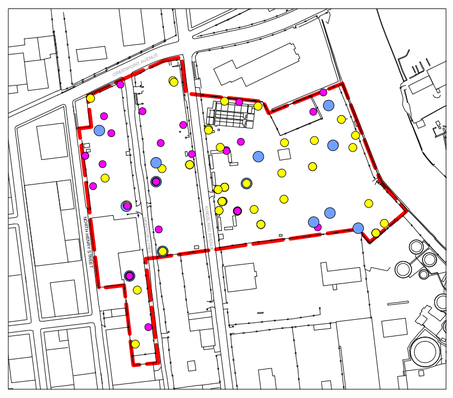
CHROMIUM



Chromium by Concentration
Standard = 50 ug/L

- ND
- >ND to 50
- 50 to 500
- 500 to 5,000

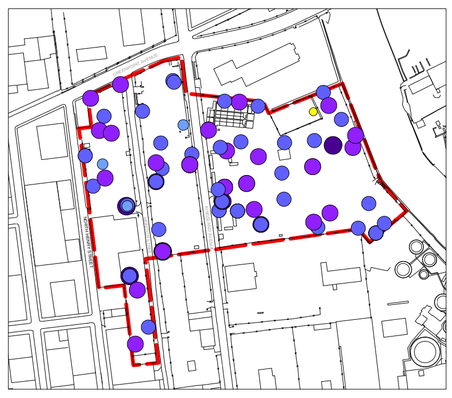
COPPER



Copper by Concentration
Standard = 200 ug/L

- ND
- >ND to 200
- 200 to 2,000
- 2,000 to 20,000

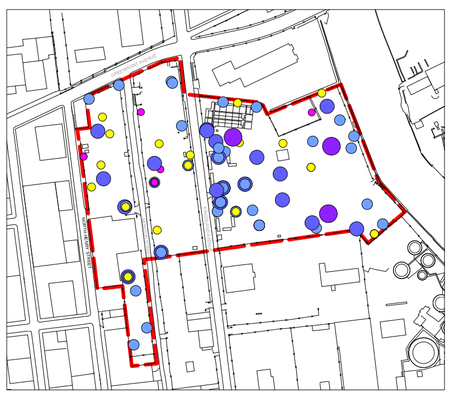
IRON



Iron by Concentration
Standard = 300 ug/L

- ND
- >ND to 300
- 300 to 3,000
- 3,000 to 30,000
- 30,000 to 300,000
- 300,000 to 3,000,000

LEAD



Lead by Concentration
Standard = 25 ug/L

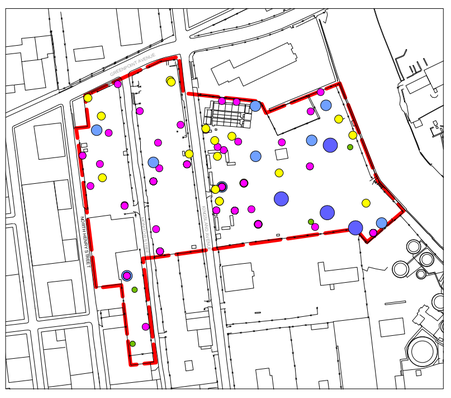
- ND
- >ND to 25
- 25 to 250
- 250 to 2,500
- 2,500 to 25,000

MANGANESE

Manganese Concentration
Standard = 300 ug/L

- ND
- >ND to 300
- 300 to 3,000
- 3,000 to 30,000
- 30,000 to 300,000

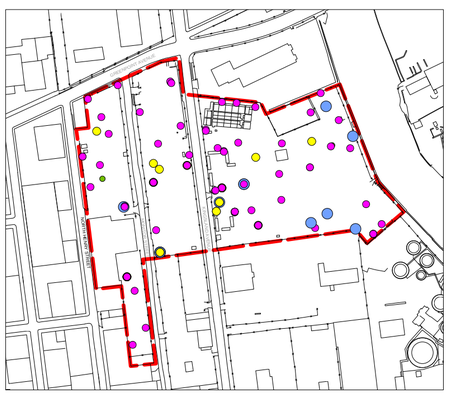
MERCURY



Mercury by Concentration
Standard = 0.7 ug/L

- ND
- >ND to 0.7
- 0.7 to 7
- 7 to 70

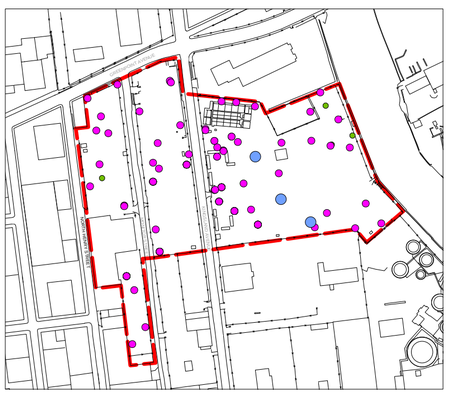
NICKEL



Nickel by Concentration
Standard = 100 ug/L

- ND
- >ND to 100
- 100 to 1,000
- 1,000 to 10,000

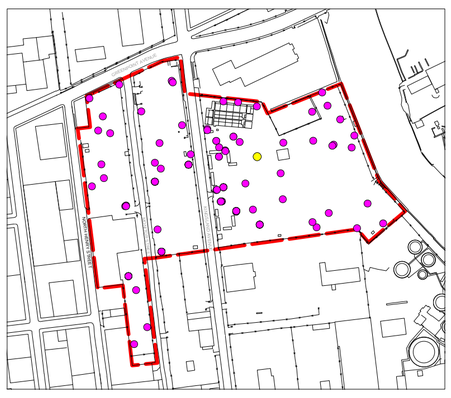
SELENIUM *



Selenium by Concentration
Standard = 10 ug/L

- ND
- >ND to 10
- 10 to 100
- 100 to 1,000

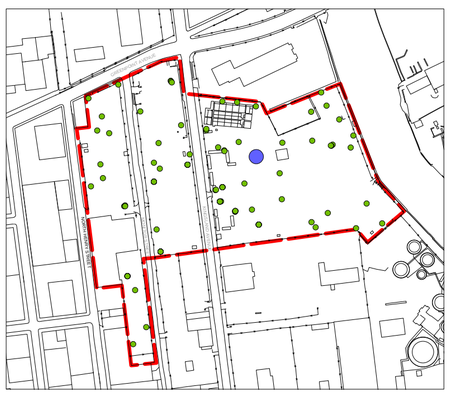
SILVER *



Silver Concentration
Standard = 50 ug/L

- ND
- >ND to 50
- 50 to 500

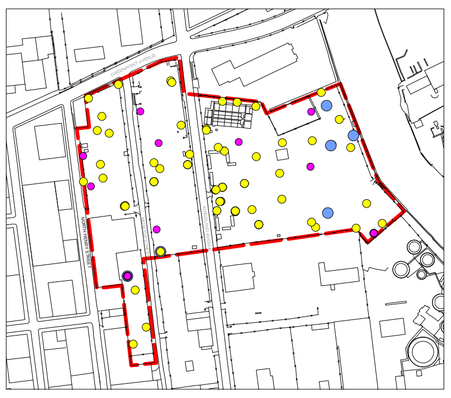
THALLIUM *



Thallium by Concentration
Standard = 0.5 ug/L

- ND
- >ND to 0.5
- 0.5 to 5
- 5 to 50

ZINC



Zinc by Concentration
Standard = 2000 ug/L

- ND
- >ND to 2,000
- 2,000 to 20,000

GROUNDWATER
SAMPLING LOCATIONS
FOR METAL ANALYSIS

LEGEND

- INDICATES LOCATION WITH METAL CONCENTRATION BELOW AWQSGVs.
- INDICATES SAMPLE LOCATIONS WHERE THE LABORATORY REPORTING LIMIT EXCEEDED THE REGULATORY STANDARD FOR A PARTICULAR COMPOUND (I.E., COMPARISON TO STANDARDS IS INCONCLUSIVE).
- FORMER EXXONMOBIL BROOKLYN TERMINAL
- * DATA FOR THESE COMPOUNDS ARE NOT AVAILABLE FOR RECOVERY WELLS.
- UG/L MICROGRAMS PER LITER

NOTES:

1. GROUNDWATER BENEATH THE PROJECT AREA IS IMPCATED BY HISTORIC SALTWATER INTRUSION DUE TO HISTORICAL GROUNDWATER PUMPING. ALKALI METALS RELATED TO SALTWATER INTRUSION ARE NOT SHOWN.

2. CONCENTRATIONS OF EACH COMPOUND ARE COMPARED TO NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION (NYSDEC) AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES (AWQSGVS) FOR CLASS GA GROUNDWATER.

3. METALS SHOWN WERE SELECTED BASED UPON AT LEAST ONE EXCEEDANCE OF THEIR RESPECTIVE AWQSGVS.

4. MONITORING WELLS WERE ANALYZED VIA SW 846 METHODS, WHEREAS RECOVERY WELLS WERE ANALYZED VIA EPA 200.7. THEREFORE, ANALYTICAL RESULTS FOR SOME METALS ARE NOT AVAIALBE FOR RECOVERY WELLS.

N

Title:

METALS ABOVE AWQSGVS FOR CLASS GA GROUNDWATER

EXXONMOBIL
GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES INC *Environmental Consulting & Management*	Compiled by: B.P.	Date: 17MAY2012	PLATE 17
	Prepared by: B.P.	Scale: NOT TO SCALE	
	Project Mgr: C.P.	Project: 0172.0030Y030	
	File No: 0172.0030E1875.125.WOR		

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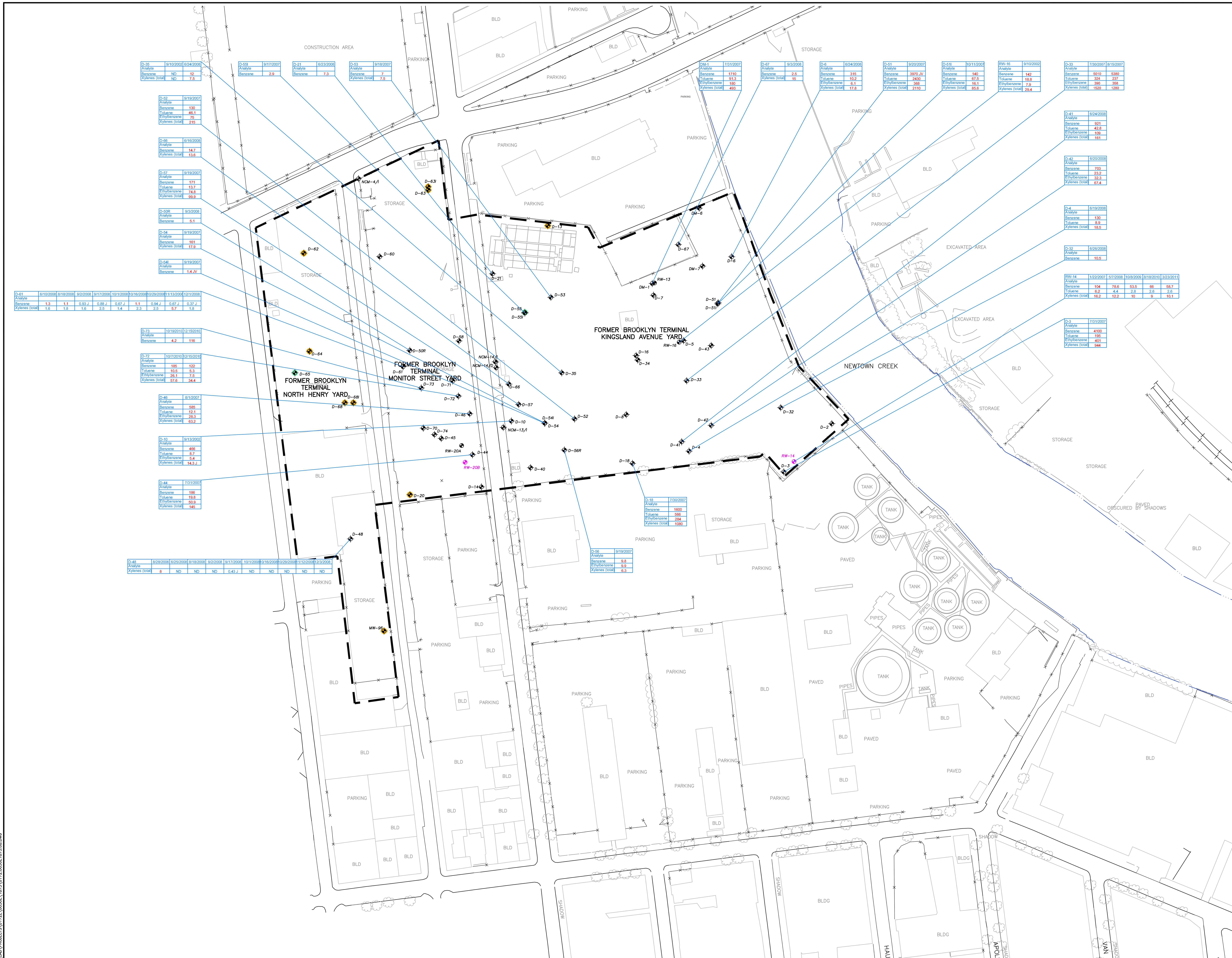

D-35	9/10/2002	6/24/2008
Analyte		
Benzene	ND	12
Xylenes (total)	ND	7.5

D-55I	9/17/2007
Analyte	
Benzene	2.9

D-21	6/23/2008
Analyte	
Benzene	7.3

D-53	9/18/2007
Analyte	
Benzene	7
Xylenes (total)	7.5

D-52	9/19/2007
Analyte	
Benzene	130
Toluene	46.1
Ethylbenzene	75
Xylenes (total)	215

D-66	6/16/2008
Analyte	
Benzene	14.7
Xylenes (total)	13.6

D-57	9/19/2007
Analyte	
Benzene	171
Toluene	13.7
Ethylbenzene	74.8
Xylenes (total)	99.9

D-50R	9/3/2008
Analyte	
Benzene	5.1

D-54	9/19/2007
Analyte	
Benzene	161
Xylenes (total)	17.9

D-54I	9/19/2007
Analyte	
Benzene	1.4 JV

D-61	6/10/2008	8/18/2008	9/2/2008	9/17/2008	10/1/2008	10/16/2008	10/29/2008	11/13/2008	12/1/2008
Analyte									
Benzene	1.3	1.1	0.93 J	0.88 J	0.67 J	1.1	0.94 J	0.67 J	0.37 J
Xylenes (total)	1.6	1.8	1.6	2.5	1.4	2.3	2.5	5.7	1.8

D-73	10/19/2010	12/15/2010
Analyte		
Benzene	4.2	116

D-72	10/7/2010	12/15/2010
Analyte		
Benzene	185	122
Toluene	10.5	5.3
Ethylbenzene	26.1	7.5
Xylenes (total)	57.6	34.4

D-46	8/1/2007
Analyte	
Benzene	585
Toluene	12.1
Ethylbenzene	28.3
Xylenes (total)	63.2

D-10	9/13/2002
Analyte	
Benzene	466
Toluene	8.7
Ethylbenzene	5.4
Xylenes (total)	14.3 J

D-44	7/31/2007
Analyte	
Benzene	186
Toluene	19.8
Ethylbenzene	50.9
Xylenes (total)	145

D-48	8/28/2006	6/25/2008	8/18/2008	9/2/2008	9/17/2008	10/1/2008	10/16/2008	10/29/2008	11/12/2008	12/3/2008
Analyte										
Xylenes (total)	8	ND	ND	ND	0.43 J	ND	ND	ND	ND	ND

DM-1	7/31/2007
Analyte	
Benzene	1710
Toluene	91.3
Ethylbenzene	180
Xylenes (total)	493

D-67	9/3/2008
Analyte	
Benzene	2.5
Xylenes (total)	15

D-6	6/24/2008
Analyte	
Benzene	315
Toluene	10.2
Ethylbenzene	6.1
Xylenes (total)	17.8

D-51	9/20/2007
Analyte	
Benzene	3970 JV
Toluene	2430
Ethylbenzene	368
Xylenes (total)	2110

D-51I	10/11/2007
Analyte	
Benzene	140
Toluene	67.5
Ethylbenzene	16.1
Xylenes (total)	85.6

RW-16	9/10/2002
Analyte	
Benzene	142
Toluene	18.8
Ethylbenzene	7.9
Xylenes (total)	29.4

D-33	7/30/2007	8/15/2007
Analyte		
Benzene	5010	5380
Toluene	324	237
Ethylbenzene	390	358
Xylenes (total)	1520	1280

D-41	6/24/2008
Analyte	
Benzene	921
Toluene	42.8
Ethylbenzene	109
Xylenes (total)	161

D-42	6/20/2008
Analyte	
Benzene	703
Toluene	23.2
Ethylbenzene	32.3
Xylenes (total)	67.4

D-4	6/19/2008
Analyte	
Benzene	130
Toluene	8.9
Xylenes (total)	18.5

D-32	6/26/2008
Analyte	
Benzene	10.5

RW-14	1/22/2007	5/7/2008	10/8/2009	8/18/2010	3/23/2011
Analyte					
Benzene	104	78.6	53.5	66	58.7
Toluene	6.2	4.4	2.8	2.6	2.6
Xylenes (total)	16.2	12.2	10	9	10.1

D-3	7/31/2007
Analyte	
Benzene	4100
Toluene	195
Ethylbenzene	401
Xylenes (total)	944

D-18	7/30/2007
Analyte	
Benzene	1600
Toluene	566
Ethylbenzene	284
Xylenes (total)	1080

D-56	9/19/2007
Analyte	
Benzene	9.8
Ethylbenzene	9.9
Xylenes (total)	6.3

LEGEND

- EXISTING FENCELINE
- EDGE OF WATER (APPROXIMATE)
- EXISTING ABOVEGROUND STORAGE TANK WITH DESIGNATION
- EXISTING BUILDING / STRUCTURE DESIGNATION
- D-18 LOCATION AND DESIGNATION OF REGIONAL AQUIFER (CONFINED) MONITORING WELL
- RW-14 LOCATION AND DESIGNATION OF REGIONAL AQUIFER RECOVERY WELL
- NCM-4/I LOCATION AND DESIGNATION OF NYCDEP MONITORING WELL
- MONITORING WELLS WITHOUT DETECTABLE BTEX CONCENTRATIONS
- MONITORING WELLS WITH BTEX CONCENTRATIONS BELOW AWQSGVs
- ND NOT DETECTED

KEY

DESIGNATION — DATE

D-32	6/26/2008
Analyte	
Benzene	10.5

CONCENTRATION (µg/L)

BTEX BENZENE, TOLUENE, ETHYLBENZENE, XYLENES
µg/L MICROGRAMS PER LITER
J ESTIMATED VALUE
ND NOT DETECTED
JV LAB QUALIFIER WAS CHANGED TO 'J' DURING DATA VALIDATION
RED INDICATES VALUE EXCEEDS NYSDEC AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES (AWQSGVs)

GUIDANCE VALUES

Parameter	(µg/L)
Benzene	1
Toluene	5
Ethylbenzene	5
Xylenes (total)	5

NOTES

1. BASE MAP PREPARED FROM AERIAL SURVEY PERFORMED BY ANGLE OF ATTACK LAND SURVEYING, LLC, MAY 2001. ALL TOPOGRAPHIC AND PLANIMETRIC DETAILS WERE PREPARED USING PHOTOGRAMMETRIC METHODS.
2. HORIZONTAL LOCATIONS ARE BASED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
3. ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
4. FOR LOCATIONS THAT WERE SAMPLED MORE THAN ONCE PER YEAR, ONLY THE HIGHEST CONCENTRATION THAT WAS DETECTED DURING EACH YEAR AND THE MOST RECENT CONCENTRATION ARE SHOWN.

100' 0 100'

Title:

BTEX EXCEEDANCES DETECTED IN REGIONAL AQUIFER GROUNDWATER SAMPLES

GREENPOINT, BROOKLYN, NEW YORK
EXXONMOBIL GREENPOINT PETROLEUM REMEDIATION PROJECT

Prepared For: EXXONMOBIL OIL CORPORATION, BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC. Environmental Consulting and Management

Compiled by: M.R.	Date: 15MAY12	PLATE
Prepared by: G.M.	Scale: AS SHOWN	18
Project Mgr: J.P.K.	Project: 0172.0030E030	
File: 0172.0030E1875.08.DWG		

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D-50R	9/3/2036
Analyte	
MTBE	17.2

D-60	6/9/2008
Analyte	
MTBE	13.9

DM-6	6/27/2008
Analyte	
MTBE	17.2

D-52	9/19/2007
Analyte	
MTBE	30.6

RW-16	9/10/2002
Analyte	
MTBE	32.3

D-62	6/17/2008
Analyte	
MTBE	13.6

D-18	7/30/2007
Analyte	
MTBE	122

D-51	9/2/2008	7/13/2010	12/15/2010
Analyte			
MTBE	15	14.7	6.3

RW-14	1/22/2007	5/7/2008	2/12/2009	12/9/2010	3/23/2011
Analyte					
MTBE	92.8	49	36.3	22.1	28

D-72	7/12/2010	12/15/2010
Analyte		
MTBE	39.7	9.9

D-65	6/17/2008
Analyte	
MTBE	29

D-46	8/1/2007
Analyte	
MTBE	57.4

D-10	9/13/2002
Analyte	
MTBE	61.6

D-54	9/19/2007
Analyte	
MTBE	51.3

D-56	9/19/2007
Analyte	
MTBE	178

MW-96	1/18/2007	6/25/2008
Analyte		
MTBE	126	49.2

FORMER BROOKLYN TERMINAL NORTH HENRY YARD

FORMER BROOKLYN TERMINAL MONITOR STREET YARD

FORMER BROOKLYN TERMINAL KINGSLAND AVENUE YARD

NEWTOWN CREEK

LEGEND

- FORMER EXXONMOBIL BROOKLYN TERMINAL
- EXISTING FENCELINE
- EDGE OF WATER (APPROXIMATE)
- EXISTING ABOVEGROUND STORAGE TANK WITH DESIGNATION
- EXISTING BUILDING / STRUCTURE DESIGNATION
- D-18 — LOCATION AND DESIGNATION OF REGIONAL AQUIFER (CONFINED) MONITORING WELL
- RW-14 — LOCATION AND DESIGNATION OF REGIONAL AQUIFER RECOVERY WELL
- NCM-4/1 — LOCATION AND DESIGNATION OF NYCDEP MONITORING WELL
- WELLS WITHOUT DETECTABLE MTBE CONCENTRATIONS
- WELLS WITH MTBE CONCENTRATIONS BELOW AWQSGVs

KEY

DESIGNATION — D-18 | 7/30/2007 | Analyte | MTBE | 122 — DATE; CONCENTRATION (µg/L)

MTBE METHYL TERT-BUTYL ETHER
µg/L MICROGRAMS PER LITER
J ESTIMATED VALUE
ND NOT DETECTED
RED INDICATES VALUE EXCEEDS NYSDEC AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES (AWQSGVs)

GUIDANCE VALUE

Parameter	(ug/L)
MTBE	10

NOTES

1. BASE MAP PREPARED FROM AERIAL SURVEY PERFORMED BY ANGLE OF ATTACK LAND SURVEYING, LLC, MAY 2001. ALL TOPOGRAPHIC AND PLANIMETRIC DETAILS WERE PREPARED USING PHOTOGRAMMETRIC METHODS.
2. HORIZONTAL LOCATIONS ARE BASED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
3. ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
4. FOR LOCATIONS THAT WERE SAMPLED MORE THAN ONCE PER YEAR, ONLY THE HIGHEST CONCENTRATION THAT WAS DETECTED DURING EACH YEAR AND THE MOST RECENT CONCENTRATION ARE SHOWN.

100' 0 100'

Title:

MTBE EXCEEDANCES DETECTED IN REGIONAL AQUIFER GROUNDWATER SAMPLES

GREENPOINT, BROOKLYN, NEW YORK
EXXONMOBIL GREENPOINT PETROLEUM REMEDIATION PROJECT

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting and Management

Compiled by: M.R.	Date: 15MAY12	PLATE
Prepared by: G.M.	Scale: AS SHOWN	19
Project Mgr: J.P.K.	Project: 0172.0030E030	
File: 0172.0030E1875.09.DWG		

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D-63	6/13/2008
Analyte	
Vinyl chloride	16.8

D-13	6/23/2008
Analyte	
Vinyl chloride	3.5

D-21	6/23/2008
Analyte	
1,2 Dichloroethene (cis)	19.3
Vinyl chloride	8.3

D-6	6/24/2008
Analyte	
Vinyl chloride	9.4

RW-14	1/22/2007	5/7/2008	10/8/2009	6/18/2010	3/23/2011
Analyte					
Trichloroethene	5.5	5	5.6	6.3	3.7
1,2 Dichloroethene (cis)	41.8	31.6	20.6	19.1	13.7
Vinyl chloride	13.3	8.6	2.7	2.5	2

CONSTRUCTION AREA
PARKING
BLD
STORAGE
EXCAVATED AREA
PAVED
OBSCURED BY SHADOWS
SHADOW
TANK
PIPES
NEWTOWN CREEK
FORMER BROOKLYN TERMINAL NORTH HENRY YARD
FORMER BROOKLYN TERMINAL MONITOR STREET YARD
FORMER BROOKLYN TERMINAL KINGSLAND AVENUE YARD
BLDG
HAUSMAN STREET
APOLLO STREET
VAN DAM STREET
BRIDGE

NCM-4/I, D-63, D-62, D-60, D-13, D-21, D-67, DM-6, DM-7, DM-1, RW-13, D-7, D-6, D-51, D-51I, D-53, D-55, D-55S, D-58, D-50R, D-64, D-65, D-68, D-68I, D-69, D-61, D-77, D-73, D-72, D-66, NCM-14/I, NCM-14/D, D-35, D-57, D-46, D-70, D-74, D-45, RW-20A, D-44, RW-20B, D-14, D-20, D-10, NCM-13/I, D-541, D-54, D-52, D-56R, D-56, D-40, D-18, D-8, D-41, D-4, D-42, D-16, D-34, D-5, RW-16, D-43, D-33, D-32, D-2, RW-14, D-3

LEGEND

- FORMER EXXONMOBIL BROOKLYN TERMINAL
- EXISTING FENCELINE
- EDGE OF WATER (APPROXIMATE)
- EXISTING ABOVEGROUND STORAGE TANK WITH DESIGNATION
- EXISTING BUILDING / STRUCTURE DESIGNATION
- D-18 — LOCATION AND DESIGNATION OF REGIONAL AQUIFER (CONFINED) MONITORING WELL
- RW-D — LOCATION AND DESIGNATION OF REGIONAL AQUIFER RECOVERY WELL
- NCM-4/I — LOCATION AND DESIGNATION OF NYCDEP MONITORING WELL
- WELLS WITHOUT DETECTABLE CVOC CONCENTRATIONS
- WELLS WITH CVOC CONCENTRATIONS BELOW AWQSGVs

KEY

DESIGNATION — DATE

D-6	6/24/2008
Analyte	
Vinyl chloride	9.4

CONCENTRATION (µg/L)

CVOC	CHLORINATED VOLATILE ORGANIC COMPOUNDS
µg/L	MICROGRAMS PER LITER
J	ESTIMATED VALUE
ND	NOT DETECTED
NS	NOT SAMPLED
NA	NOT ANALYZED
RED	INDICATES VALUE EXCEEDS NYSDEC AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES (AWQSGVs)

GUIDANCE VALUE

Parameter	(µg/L)
Tetrachloroethene	5
Trichloroethene	5
1,2 Dichloroethene (cis)	5
Vinyl chloride	2

NOTES

1. BASE MAP PREPARED FROM AERIAL SURVEY PERFORMED BY ANGLE OF ATTACK LAND SURVEYING, LLC, MAY 2001. ALL TOPOGRAPHIC AND PLANIMETRIC DETAILS WERE PREPARED USING PHOTOGRAMMETRIC METHODS.
2. HORIZONTAL LOCATIONS ARE BASED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
3. ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
4. FOR LOCATIONS THAT WERE SAMPLED MORE THAN ONCE PER YEAR, ONLY THE HIGHEST CONCENTRATION THAT WAS DETECTED DURING EACH YEAR AND THE MOST RECENT CONCENTRATION ARE SHOWN.

100' 0 100'

Title:

CVOC EXCEEDANCES DETECTED IN REGIONAL AQUIFER GROUNDWATER SAMPLES

GREENPOINT, BROOKLYN, NEW YORK
EXXONMOBIL GREENPOINT PETROLEUM REMEDIATION PROJECT

Prepared For: EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting and Management

Compiled by: M.R.	Date: 15MAY12	PLATE
Prepared by: G.M.	Scale: AS SHOWN	20
Project Mgr: J.P.K.	Project: 0172.0030E030	
File: 0172.0030E1875.10.DWG		

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S-35	6/9/2006
Analyte	
Benzene	16.7

S-11	6/19/2008
Analyte	
Benzene	4.7

W-79	6/23/2008
Analyte	
Benzene	4.8
Xylenes (total)	13.4

S-10	5/15/2002	5/19/2003	5/10/2004	5/12/2005	5/18/2006	6/23/2008
Analyte						
Benzene	2.3	2.6	0.9 J	1.1	ND	ND

S-28	9/18/2007
Analyte	
Benzene	76.5
Toluene	12.2
Ethylbenzene	20.5
Xylenes (total)	93.7

S-15	9/20/2007
Analyte	
Benzene	99.8
Toluene	234 JV
Ethylbenzene	70.1
Xylenes (total)	465

S-22	9/18/2007
Analyte	
Benzene	747
Toluene	674
Ethylbenzene	131
Xylenes (total)	914

S-19	9/20/2007
Analyte	
Benzene	175
Toluene	173
Ethylbenzene	91.5
Xylenes (total)	263

S-51	9/20/2007
Analyte	
Benzene	1.7 JV

S-30	9/25/2007
Analyte	
Benzene	132
Toluene	52.1
Ethylbenzene	249
Xylenes (total)	384

S-14	9/20/2007
Analyte	
Benzene	29.1
Toluene	6.8
Xylenes (total)	13.7

S-31	9/25/2007
Analyte	
Benzene	344
Toluene	8.1
Ethylbenzene	11.9
Xylenes (total)	51.2

S-32	9/25/2007
Analyte	
Benzene	41.1
Ethylbenzene	15.1
Xylenes (total)	21.3

S-34	9/25/2007
Analyte	
Benzene	42
Toluene	5.3
Xylenes (total)	7.1

S-1	5/15/2002	5/19/2003	5/10/2004	5/12/2005	5/18/2006	6/26/2008
Analyte						
Benzene	ND	ND	ND	ND	ND	13.5

S-44	6/18/2008
Analyte	
Benzene	82.9
Xylene (total)	6.7

S-46	6/12/2008
Analyte	
Benzene	175
Toluene	8.4
Ethylbenzene	9
Xylenes (total)	45.3

RW-15	9/10/2002
Analyte	
Benzene	44.1
Toluene	5.8
Ethylbenzene	2.4
Xylenes (total)	14.5

S-48	6/18/2008
Analyte	
Benzene	130
Toluene	7.4
Ethylbenzene	5.3
Xylenes (total)	12.5

S-70	9/3/2008
Analyte	
Benzene	86.4
Xylenes (total)	8.9

S-58	6/12/2008	9/16/2008	12/4/2008
Analyte			
Benzene	32	7.5	0.79 J
Toluene	13.4	12.6	0.65 J
Ethylbenzene	6.7	6.6	1.1
Xylenes (total)	145	110	11.4

S-73	9/22/2010
Analyte	
Benzene	3.5

S-21	9/18/2007
Analyte	
Benzene	90.3 JV
Toluene	84.3 JV
Ethylbenzene	72.2 JV
Xylenes (total)	637 JV

S-20	9/17/2007
Analyte	
Benzene	17.8
Xylenes (total)	23.1

S-23	9/18/2007
Analyte	
Benzene	14
Xylenes (total)	5.3

S-17	9/24/2007
Analyte	
Benzene	11.6
Xylenes (total)	9.6

S-18	9/19/2007	12/4/2008	7/14/2010
Analyte			
Benzene	53.9	5.2	3.4
Toluene	84.5	2	1.1
Ethylbenzene	27.7	1.1	0.47 J
Xylenes (total)	165	4.2	2.2

S-27	9/18/2007	10/30/2008	8/27/2010
Analyte			
Benzene	26	ND	5.7
Xylenes (total)	6.8	5.7	4.5

S-54	9/19/2007	12/4/2008	8/30/2010
Analyte			
Benzene	1.9	1.4	1.9
Toluene	0.9 J	ND	6.9
Xylenes	3.1	1.3	26.4

S-57	9/19/2007	9/16/2008	8/26/2010
Analyte			
Benzene	26.2 JV	1.7	1.2
Toluene	7.8 JV	1.7	0.67 J
Ethylbenzene	41.2 JV	1.8	0.67 J
Xylenes (total)	56.2 JV	6.7	2.5

W-1	5/15/2002	5/19/2003	5/19/2004	5/12/2005	5/18/2006
Analyte					
Benzene	2.8	21.4	1.4	ND	ND

CONSTRUCTION AREA
EXISTING OIL/WATER SEPARATOR
FORMER BROOKLYN TERMINAL NORTH HENRY YARD
FORMER BROOKLYN TERMINAL MONITOR STREET YARD
FORMER BROOKLYN TERMINAL KINGSLAND AVENUE YARD
NEWTOWN CREEK
EXCAVATED AREA
OBSCURED BY SHADOWS
PIPES
TANK
KINGSLAND AVENUE
SUTTON STREET
MORGAN AVENUE
HAUSMAN STREET
APOLLO STREET
VAN DAM STREET
BRIDGEWATER STREET
VARICK STREET

LEGEND

- FORMER EXXONMOBIL BROOKLYN TERMINAL
- EXISTING FENCELINE
- EDGE OF WATER (APPROXIMATE)
- (2) EXISTING ABOVEGROUND STORAGE TANK WITH DESIGNATION
- BLD EXISTING BUILDING / STRUCTURE DESIGNATION
- S-35 LOCATION AND DESIGNATION OF EXISTING SHALLOW AQUIFER MONITORING WELL
- RW-15 LOCATION AND DESIGNATION OF EXISTING SHALLOW AQUIFER RECOVERY WELL
- NCM-4/S LOCATION AND DESIGNATION OF EXISTING NYCDEP MONITORING WELL WITH CONSTRUCTION DESIGNATION (APPROXIMATE LOCATION) (S=SHALLOW AQUIFER)
- MONITORING WELLS WITHOUT DETECTABLE BTEX CONCENTRATIONS
- MONITORING WELLS WITH BTEX CONCENTRATIONS BELOW AWQSGVs
- ND NOT DETECTED
- BTEX BENZENE, TOLUENE, ETHYLBENZENE, XYLENE (TOTAL)

KEY

SAMPLE DESIGNATION — SAMPLE DATE

S-44	6/18/2008
Analyte	
Benzene	82.9
Xylene (total)	6.7

CONCENTRATION (ug/L)

- (ug/L) MICROGRAMS PER LITER
- J ESTIMATED VALUE
- JV LAB QUALIFIER WAS CHANGED TO "J" FOLLOWING DATA VALIDATION
- NS NOT SAMPLED
- RED INDICATES VALUE EXCEEDS NYSDEC AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES (AWQSGVs)

GUIDANCE VALUE

PARAMETER	(ug/L)
Benzene	1
Toluene	5
Ethylbenzene	5
Xylenes (total)	5

NOTES

1. BASE MAP PREPARED FROM AERIAL SURVEY PERFORMED BY ANGLE OF ATTACK LAND SURVEYING, LLC, MAY 2001. ALL TOPOGRAPHIC AND PLANIMETRIC DETAILS WERE PREPARED USING PHOTOGRAMMETRIC METHODS.
2. HORIZONTAL LOCATIONS ARE BASED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
3. ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
4. DATA IS ONLY SHOWN FOR LOCATIONS WHERE ONE OR MORE COMPOUND EXCEEDED ITS AWQSGV. DATA FOR LOCATIONS WHERE NO EXCEEDANCE WAS DETECTED IS NOT INCLUDED.
5. FOR LOCATIONS THAT WERE SAMPLED MORE THAN ONCE PER YEAR, ONLY THE HIGHEST CONCENTRATIONS DETECTED DURING EACH YEAR AND THE MOST RECENT CONCENTRATIONS ARE SHOWN.

100' 0 100'

Title:

BTEX EXCEEDANCES DETECTED IN SHALLOW AQUIFER GROUNDWATER SAMPLES

EXXONMOBIL GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:
EXXONMOBIL OIL CORPORATION
BROOKLYN, NEW YORK

ROUX ASSOCIATES, INC.
Environmental Consulting and Management

Compiled by: B.P.	Date: 15MAY12	PLATE
Prepared by: G.M.	Scale: AS SHOWN	21
Project Mgr: C.P.	Project: 0172.0030E.030	
File: 0172.0030E1875.11.DWG		

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W-44	6/25/2008
Analyte	
MTBE	11.2

S-44	6/18/2008
Analyte	
MTBE	52.5

S-46	6/12/2008
Analyte	
MTBE	42.9

W-45	5/15/2002	5/19/2003	5/10/2004	5/12/2005	5/18/2006	6/25/2008
Analyte						
MTBE	48.2	15.2	13.4	11.9	6.3	4.6

S-35	6/9/2008
Analyte	
MTBE	21

RW-15	9/10/2002
Analyte	
MTBE	179

S-49	6/18/2008
Analyte	
MTBE	319

S-50	6/18/2008
Analyte	
MTBE	41.9

S-10	5/15/2002	5/19/2003	5/10/2004	5/12/2005	5/18/2006	6/23/2008
Analyte						
MTBE	13.5	10.3	3	3	1.2	ND

W-79	6/23/2008
Analyte	
MTBE	125

S-26	9/18/2007
Analyte	
MTBE	48.5

S-20	9/17/2007
Analyte	
MTBE	38.8

S-58	10/15/2008
Analyte	
MTBE	16.5

S-27	9/18/2007	10/21/2010
Analyte		
MTBE	16.1	1.3

S-54	9/19/2007	9/10/2010
Analyte		
MTBE	2.3	1.7

S-18	9/19/2007	9/23/2010
Analyte		
MTBE	3.3	6.4

S-32	9/25/2007
Analyte	
MTBE	13.6

S-34	9/25/2007
Analyte	
MTBE	10.3

EXISTING OIL/WATER SEPARATOR

FORMER BROOKLYN TERMINAL KINGSLAND AVENUE YARD

FORMER BROOKLYN TERMINAL MONITOR STREET YARD

FORMER BROOKLYN TERMINAL NORTH HENRY YARD

NEWTOWN CREEK

KINGSLAND AVENUE · SUTTON STREET · MORGAN AVENUE · HAUSMAN STREET · APOLLO STREET · VAN DAM STREET · BRIDGEWATER STREET · VARICK STREET

LEGEND

- FORMER EXXONMOBIL BROOKLYN TERMINAL
- EXISTING FENCELINE
- EDGE OF WATER (APPROXIMATE)
- (2) EXISTING ABOVEGROUND STORAGE TANK WITH DESIGNATION
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- RW-15 LOCATION AND DESIGNATION OF EXISTING SHALLOW AQUIFER RECOVERY WELL
- NCM-4/S LOCATION AND DESIGNATION OF EXISTING NYCDEP MONITORING WELL WITH CONSTRUCTION DESIGNATION (APPROXIMATE LOCATION) (S=SHALLOW AQUIFER)
- WELLS WITHOUT DETECTABLE MTBE CONCENTRATIONS
- WELLS WITH MTBE CONCENTRATIONS BELOW AWQSGVs
- ND NOT DETECTED
- MTBE METHYL TERT-BUTYL ETHER

KEY

SAMPLE DESIGNATION — SAMPLE DATE

S-32	9/25/2007
Analyte	
MTBE	13.6

CONCENTRATION (ug/L)

- (ug/L) MICROGRAMS PER LITER
- ND NOT DETECTED
- RED INDICATES VALUE EXCEEDS NYSDEC AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES (AWQSGVs)

GUIDANCE VALUE

PARAMETER	(ug/L)
MTBE	10

NOTES

1. BASE MAP PREPARED FROM AERIAL SURVEY PERFORMED BY ANGLE OF ATTACK LAND SURVEYING, LLC, MAY 2001. ALL TOPOGRAPHIC AND PLANIMETRIC DETAILS WERE PREPARED USING PHOTOGRAMMETRIC METHODS.
2. HORIZONTAL LOCATIONS ARE BASED ON THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
3. ELEVATIONS ARE BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
4. DATA IS SHOWN FOR LOCATIONS WHERE AT LEAST ONE EXCEEDANCE OF THE AWQSGV FOR MTBE WAS DETECTED.
5. FOR LOCATIONS THAT WERE SAMPLED MORE THAN ONCE PER YEAR, ONLY THE HIGHEST CONCENTRATION THAT WAS DETECTED DURING EACH YEAR AND THE MOST RECENT CONCENTRATION ARE SHOWN.

100' 0 100'

Title:

MTBE EXCEEDANCES DETECTED IN SHALLOW AQUIFER GROUNDWATER SAMPLES

EXXONMOBIL GREENPOINT PETROLEUM REMEDIATION PROJECT
GREENPOINT, BROOKLYN, NEW YORK

Prepared For:
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